STRUCTURED PROPOSITIONS[1]

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0. SOME THESES

I would like to start this article with some theses. None of them is uncontroversial, but each seems to be correct, as I will try to show. The paper itself will not follow the exact order in which the thesis appear. It is sometimes a Heraclitian (or Chomskyan) stream of thought. Our views change while we go on. But, at the end, a picture emerges whose main contours are the following claims.

The **main thesis** of this article is this: the content of a sentence is, in general, not a set of possible worlds (a **"classical" proposition**) but a **"structured" proposition**, a pair **<P, <a_1, ..., a_n>>**, where **P** is a property and a_1**, ...,** a_n are appropriate arguments.

This small modification of a view which is commonly accepted among possible- world semanticists has far reaching consequences. As far as I can see, it allows for a new and promising approach to a number of problems which seemed to be insurmountable from the point of view of the classical theory:

The problem of propositional attitudes, the problem of essential indexicals, the Frege-problem, the Lakoff-puzzle, the semantics of topic and focus and the semantics of interrogatives.

The **second thesis** of this paper is that there is an **intensional** analysis for each of these phenomena. There is no need to give up intensional semantics in favour of some conceptually different framework.

In Stechow and Cresswell (1981) we have dealt extensively with propositional attitudes. So this problem is treated here **en passant** only. I will concentrate instead on problems which were not explicitly dealt with in the article just quoted. The largest part of the paper is devoted to the problem of „essential indexicals".

I am not beginning with my own views, but I first investigate possible alternative approaches to this problem. Particular attention is given to a discussion of Robert Stalnaker's diagonalization method. I propose a generalization of Stalnaker's method. The discussion will lead to the **third thesis**:

The method of diagonalization, though a very important contribution to an understanding of the problem of essential indexicals, is not enough to solve it. Since the problem of propositional attitudes and the Frege-problem are intimately connected with this problem, it follows that Stalnaker can't solve these problems in a general way either.

The **fourth thesis** maintains that the problem of essential indexicals can be solved within a theory of structured propositions. As a corollary we also get a solution to the Frege-Problem.

This paper is contained in a volume about questions and answers. My **fifth thesis** concerns interrogatives:

Alternative questions are structured propositions, and **wh**-questions are functions from individuals into structured propositions.

I thus claim that the analysis of interrogatives given by Ruth Manor is essentially correct. It follows that the analysis given by Karttunen (1977) either needs substantial revisions or else has to be given up altogether.

A minor thesis concerning interrogatives is **thesis number six**:

Interrogative-embedding operators are **structure-sensitive** ("focus-sensitive"): "God knows whether Ede loves **Senta**" will have different truth-conditions from "God knows whether **Ede** loves Senta".

This holds for operators expressing a "propositional" attitude in general. I am, thus, defending views of Fred Dretske.

One and the same expression generally expresses more than one structured proposition. Although the syntax (**e.g.** clefts) and, above all, the intonation give clues what structured proposition is expressed by a particular utterance of a sentence, the essential strategies for the determination of the content of the sentence are pragmatic. This claim may be called **thesis number seven**.

A sentence can't have, of course, any content whatsoever. It is finitely ambiguous as to propositional structure. This is **claim number eight**.

In an appendix I sketch some "rules of construal" which convert a sentence into its possible structured propositions or "logical forms" expressing them).

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1. Some strange consequences of the standard semantics of indexicals

There are very simple sentences which represent a serious problem for the standard semantics for indexicals. The following sentences belong to this treacherous kind.

(1) i. What time is it (now)?
 ii. It is (now) 3.49 a.m..

(2) i. Which mountain is this?
 ii. This is Mount Rollestone.

(3) i. Who am I?
 ii. I am Max Cresswell.

The usual semantic analyses makes the meaning of each of these sentences so trivial that there would be no point to utter any of them in everyday conversation. In view of the fact that, with the possible exception of (3 i), a philosopher's question, all of these sentences are utterly normal, this is a very strange consequence.

These are standard assumptions which entail my claim.

Assumption One. Indexicals are directly referential (in the sense of Kaplan (1977)). In particular, *I* denotes the actual speaker, *here* denotes the place where he actually is, *now* denotes the actual time and *this* denotes the place the speaker actually refers to, and so an.[2].

Assumption Two. The copulae in (1) to (3) all denote identity.

Assumption Three. Wh-interrogatives express properties. I will comment on this assumption in a minute.

[2] In Montague (1974), Lewis (1972) or Cresswell (1973) you will find the same semantics for indexicals.

According to these assumptions the meanings of (1) to (3) are something like (1‘) to (3‘) respectively.

(1‘) i. λ**t** [now = **t**]
ii. now = 3.49 a.m.

(2‘) i. λ**m** [this = **m**]
ii. this = Mount Rollestone

(3‘) i. λ**p** [I = **p**]
ii. I = Max Cresswell

(1‘) is the property which is true of a time **t** iff **t** is the actual time, and so on for the other sentences. For details of the notation, see the footnote.[3]

Before going on let me give a brief explanation why it makes sense to conceive of the meaning of **wh**-interrogatives as properties. If I ask you the property **P**, **i.e.** I say an interrogative expressing **P**, you name me an object **x** and I accept your answer, then I henceforth ascribe **P** to **x**. Consider an example.

(4) Who has been at Otaki Forks?

(4) expresses the property of having been at Otaki Forks, **i.e.** it has the „logical form“ 02(5):

(5) λ**p** [**p** has been at Otaki Forks].

If I ask you (4) and you say "Max" and I believe you, I henceforth ascribe the property (5) to Max, **i.e.** I believe that Max has the property of having been at Otaki Forks. In other words, I believe that Max has been at Otaki Forks.[4]

Let us consider (1) to (3) again. It is easy to see that we hit trouble.

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[3] A first remark concerns the choice of the variables. *What time* is represented as λ**t** [... **t** ...].

The restriction of the range of the "variable"

what to times is expressed by the letter **t**, i.e. **"t"** is a variable ranging over times. In (2‘ i), **"m"** ranges over mountains and in (3‘ i) **"p"** ranges over persons.

As for the λ-notation, the usual convention hold, **i.e.** the property λ**x** [... **x** ...] is true of **a** iff ... **a** ... .

In the present context, it is not important how properties are exactly reconstructed. The only thing that matters is that we have some intuitive understanding of the λ-notation. We will use the λ-notation not only for property abstraction but for function abstraction in general.

[4] You may choose a somewhat different analysis of interrogatives. For instance, Karttunen would analyse (5) roughly as λ**s** ($\exists$**p**)[**s** & **p** has been at Otaki Forks]. Here "**s**" ranges over propositions. So questions would be properties of propositions. It is obvious that everything I say in this paragraph can easily be accomodated so that it fits an analysis of the Karttunen type. For an analysis of interrogatives vide **e.g.** Karttunen (1977), Engdahl (1980) or Stechow (1981a).

Case One. I have lost track of time. I ask you:

(6) What time is it now?

You answer:

(7) 3.49 a.m.

I am happy with your answer and I therefore come to believe:

(8) It is now 3.49 a.m..

Suppose you speak truly. Then *now* refers to 3.49 a.m. (of a particular day). By our three assumptions, my question means therefore

(6‘) λ**t** [3.49 a.m. = **t**]

and I come to believe the following proposition:

(8‘) 3.49 a.m. = 3.49 a.m.

But this is absurd. (6‘) is not a sensible question. I know the answer to it. It is 3.49 a.m.. And (8‘) is a tautology and therefore not informative. But, intuitively, (8) is very well informative. This shows that we neither understand (6) in the sense of (6‘) nor (8) in the sense of (8‘), in the context given above.

Case Two. Remember the dialogue between us at Arthur's Pass.

(9) I [pointing to Mount Rollestone]: Which mountain is this?
You: Mount Rollestone.

Of course, I believed you. Therefore, according to our semantic assumption, the content of my question was (10i) and my new belief was (10ii).

(10) i. λ**m** [**m** = Mount Rollestone].
ii. Mount Rollestone = Mount Rollestone

Again, this can't be right. (10i) is not a sensible question, because its only true answer necessarily is Mount Rollestone, and (10ii) is an empty belief. On the other hand my question made sense, your answer conveyed some new information to me and my new belief was therefore informative.

Exactly the same point can be made with *I*.

Case Three. Tristan and I

(11) I, an amnesiac: Who am I?
Tristan: You are Max Cresswell.
I: I see, I am Max Cresswell.

Usually, Tristan doesn't make such bad jokes with me. Therefore I believe him. According to our semantic assumptions, this meaning of my question is then (12i) and my new belief is (12ii).

(12) i. λ**p** [**p** = Arnim von Stechow]
ii. Max Cresswell = Arnim von Stechow.

Of course, neither did I intend to ask (12i), a question which answers itself, nor do I believe such a queer thing as (12ii).

To make the point with *here* is a bit more complicated. The first thing we need is a semantical analysis of „locative“ copula. Consider the following sentences.

(13) i. Max is in Wellington.
ii. Tristan is here.

It is standard assumption again that in sentences of this type the copula doesn't mean identity but rather something like "being located at".[5]
Let us assume this, too:

Assumption Four. In copula-sentences with locative predicate, the copula expresses the relation "**x** is located at **y**".

So (13i) and (13ii) mean something like (14i) and (14ii) respectively.

(14) i. Max is located in Wellington.
ii. Tristan is located here.

Now we are ready for

Case Four. It's a dialogue between Max and me.

(15) i. I: Where are we here?
ii. Max: At Totara Flats.

Max is speaking the truth, of course, and I believe him. So my question should mean something like (16i) and the information conveyed by his answer should be (16ii).

(16) i. λ**l** [Max and Arnim are located at **l** and **l** = Totara Flats]
ii. Max and Arnim are located at Totara Flats.

In order to facilitate the understanding of this representation, let me remark that I think of the meaning of (15i) as something like this:

(17) λ**l** [We are located at **l** and **l** = here]

l is a variable ranging over places. In the context mentioned above, *here* denotes Totara Flats and *we* denotes Max and myself.
This amounts to the representation (16i). The meaning of the answer (15ii) is obtained by attributing the property expressed by (15i) to the location indicated by the answer, **i.e.** to Totara Flats. This gives (16ii).
But asking (16i) would be pointless because I would ask you something like this: "Name me a location which is such that Max and I are actually located there and which is identical with Totara Flats." If I am entitled to such a question, the answer could only be "Totara Flats" and I should know so. Every different answer would be wrong on logical grounds. But this is against our intuitions. If Max had answered
(17) At Waikanae Beach

[5] Cf. Lyons (1977) [p. 473 ff] and Kaplan (1977) [p. 74 ff]

instead of (15ii), he would have said something false but not something which is logically false.

So we have made acquaintance with a dilemma. An obvious semantics for indexicals, the copulae and interrogatives sometimes gives us results which conflict with our intuitions of the meaning. The sentences we considered were no marginal cases, but very simple ones, whose use and understanding seems entirely unproblematic. How should we react to this difficulty? Are our semantic assumptions, after all, not so obvious or should we "help" our intuitions a bit so that the problem disappears?

2. A CONTEXT-SENSITIVE SEMANTICS FOR INDEXICALS?

All the examples which we considered in the first paragraph have to do with what John Perry calls "essential indexicals". (vide Perry (1979)). Roughly speaking, an indexical is essential if it can't be replaced by a name without changing the meaning of the sentence in which it occurs in an unwanted way.

(1) i. David believes that it is now 3.49 a.m..
ii. David believes that it is 3.49 a.m. at 3.49 a.m..

(2) i. What time is it now?
ii. What time is it at 3.49 a.m.?

(3) i. Lingens claims that he is Hume.
ii. Lingens claims that Lingens is Hume.

In (1 ii) and (2 ii) we have replaced the indexical *now* by the name *3.49 a.m.*, in (3 ii) we have replaced *he* by *Lingens*, But the (ii)-sentences are not understood in the same way as the (i)-sentences. So *now* and *he* are essential indexicals in the (i)-sentences.

Now, the standard analysis of indexicals says that these words behave like logically proper, though context-dependent names. In different contexts of use, an indexical may denote a different object. But given a particular context of use, an indexical denotes an object and invariably the same, independent of its occurrence in a "transparent" or "opaque" linguistic context. So there ought not to be such things as essential indexicals.

The first and most natural reaction is to say that the standard account of the semantics of indexicals is wrong. Let us tentatively react so. But what would be an alternative semantics then?

The only alternative that comes to mind is a sort of Fregean move. Let us assume that in certain linguistic contexts indexicals have their standard meaning but that in certain other contexts they mean something else. Let me call such a theory a **context-sensitive semantics**. This notion is not to be confused with **context-dependency**. Deictic words are context-dependent in an obvious sense: Their denotations are generally different in different contexts of use. Still, according to the standard analysis, every indexical has only one meaning. For instance, the meaning of *I* may be thought of as a function which assigns to every context of use the speaker (or agent) at that context. The meaning of *I* is, according to the standard analysis, „context-free". It is always the same function, no matter in which linguistic context *I* occurs. A context-sensitive semantics lets the meaning of a word depend not only on the context of use but also on the linguistic environment. "Context-free" meaning rules have the form (4), "context-sensitive" meaning rules have the form (5).

(4) The meaning of the expression α is X.
(5) The meaning of the expression α is X in the linguistic context ϕ - ψ.

It is obvious, that the notion of interpretation in (5) is more general than that in (4). It is possible to say that one and the same symbol has different meanings in different contexts. In the same sense, context-sensitive grammars are more general than context-free ones.
A "Fregean" semantics makes essential use of context-sensitive meaning rules. In a transparent context a sentence denotes a truth-value, in an opaque context, it denotes a sense.

Can we do something of this sort in order to account for essential indexicals? Let us consider one of our deictic words, say *now*. A context-sensitive meaning rule should then be something like this.

(6) i. If *now* occurs in a "transparent" context, then its meaning is the function $\mathbf{f_1}$ such that for any context of use **c**, $\mathbf{f_1}$ **(c)** is the time of context **c**.
ii. If *now* occurs in a "nontransparent" context, then its meaning is the function $\mathbf{f_2}$, which is to be specified by further research.

Let us say that a *now* which occurs in a transparent context is an ordinary (inessential) indexical, whereas a *now* occurring in an opaque context is an essential indexical.
Could such a theory solve the problem of essential indexicals? I have serious doubts.

The first thing we would have to do in order to make (6) work is to say what transparent contexts are in opposition to non-transparent ones. The examples discussed so far suggest that non-transparent contexts include contexts of "propositional attitude" and interrogative contexts. In other words, if a word occurs in the scope of a verb of propositional attitude or in an interrogative context, than it occurs in a nontransparent position. This would explain, why *now* in (1 i) and (2 i), here repeated as (7 i) and (7 ii), don't have the "standard meaning" $\mathbf{f_1}$, but the meaning $\mathbf{f_2}$ (according to our context-sensitive rule (6)).

(7) i. David believes that it is now 3.49 a.m..
ii. What time is it now?

In (7 i), *now* is in the scope of *believes*, in (7 ii) it is in the scope of *?* Hence both positions of *now* are non-transparent by stipulation.

Alas, this theory is, as it stands, immediately refuted. At this very moment, Wolfgang enters. He glances at his watch and asks:

(8) "Where is Ede now?"

I have a look at my watch and say:

(9) "I believe that he is in the Pub now."

It is obvious, that in this context *now* both times refers to the actual time. So the meanings of (8) and (9) are (8') and (9') respectively.

(8') λ**l** [Ede is at 9 p.m. at **l**]

(9‘) I believe that Ede is at 9 p.m. at the Pub.

This shows that there are opaque contexts where *now* is not an essential indexical. So (6 ii) can't be right.

Let us have a look at (6i).

Do indexicals always have their "standard meaning", when they occur in transparent contexts? Consider sentence (10).

(10) It is now 3.49 a.m..

If *now* has its "standard meaning", then the meaning of (10) would be

(11) **t** = 3.49 a.m.,

where **t** either is 3.49 a.m. or a different time. In both cases we get an uninformative proposition, either a tautology or a contradiction. So it would be impossible to make use of (10) in order to convey some information. This shows that the *now* in (10) is an essential indexical. But since it occurs in a transparent context, it shouldn't be an essential indexical, according to (6i). So (6i) can't be right either.

From this I conclude that a context-sensitive semantics can't solve the problem of essential indexicals.

3. HOW DO WE UNDERSTAND SENTENCES WITH ESSENTIAL INDEXICALS?

So far, I have only said how we don't understand sentences with essential indexicals. Let us now ask the question how we interpret them. If we agree in principle on what is going on here, we are ready for an attempt toward a solution of the problem of essential indexicals. I believe that the key to a correct understanding of essential indexicals is found in Lewis (1979), though this article doesn't explicitly deal with that problem. Consider belief-sentences first.

(1) I believe that I am David Hume.

According to Lewis, every belief is self-ascription of a property. In the case of (1), we get a reasonable meaning iff we interpret this sentence as something like (2):

(2) I believe that λ**p**[**p** = David Hume].

(2) is the proposition which is true if I self-ascribe the property of being identical with David Hume. This property is entirely contingent, so the belief is nontrivial though wrong, of course. If we look at the operation which gives us the interpretation, it seems that we regard the *I* in (1) as a bound variable. In this context, our interpretation can therefore be roughly described as:

(3) „that I am David Hume“ is interpreted as λ**p**[**p** = David Hume].

According to Lewis, the object of a belief and a "propositional" attitude in general is always a property. I will say a bit more about this analysis below. This suggests a simple method of reinterpreting *that*–clauses with essential indexicals:

Form the property by abstracting over the essential indexicals, **i.e.** replace them by corresponding variables (**p** for *I*, **l** for *here***,** **t** for *now* and so on) and bind them with the λ-Operator.
Would such a procedure describe our interpretation procedure correctly? No. Consider the next example.

(4) I believe that it is now 3.49 a.m..

If we adopted the procedure just described, we would get (5).

(5) I believe λ**t[t** = 3.49 a.m.].

According to Lewis` semantics for *believe*, this is the proposition which is true if I self-ascribe the property of being the time 3.49 a.m.. But this is nonsense, because I am not a time. My unintuitive understanding of (4) rather is the following one.

(6) I believe λ**p[p** is temporally located at 3.49 a.m.].

(6) is the proposition which is true if I self-ascribe the property of being temporally located at 3.49 a.m.. It is not so obvious how we get the property λ**p**[**p** = is temporally located at 3.49 a.m.] from the "surface", **i.e.** from the *that*-clause "that it is now 3.49 a.m.". There might be a systematic procedure, but it is certainly not as simple as we first guessed. The following examples illustrate the same point.

(7) I guess this is Mount Rollestone.

My intuitive understanding of this sentence is the following one.

(8) I guess λ**p[p** is referring to Mount Rollestone].

This property is true if I self-ascribe the property of referring to Mount Rollestone. Again, we don't get this property by simply replacing the *this* in (7) by a bound variable. This would give us a property of mountains and therefore a wrong interpretation.

(9) I guess λ**m[m** = Mount Rollestone].

(9) means that I self-ascribe the property of being Mount Rollestone. But I did not mean that, when I said (7). I meant (8).
Consider a last expression of an attitude.

(10) I wish here were Otaki Forks.

The right interpretation is, ignoring the subjunctive, this:

(11) I wish λ**p[p** is located at Otaki Forks].
This is true if every buletic alternative of myself is located at Otaki Forks, **i.e.** if I wish to have the property of being located at Otaki Forks. Again, this interpretation is not obtained if we simply consider the *here* in (11) as a variable bound by abstraction. Such a procedure would yield us the absurd proposition

(12) I wish λ**l[l** = Otaki Forks].

Like most human beings I have silly wishes. But I don't have the wish of **being** Otaki Forks. I have the wish of being **at** Otaki Forks.

Let us sum up this discussion. It seems reasonable to interpret *that*-clauses which contain essential indexicals as properties. But it is not so obvious how we get these properties from the "surface syntax".

Let us go over to interrogatives now.

(13) What time is it now?

If I ask you (13), you answer me "3.49 a.m." and I am happy with your answer, then I self-ascribe the property of being temporally located at 3.49 a.m.. So (13) is understood as the following function:

(14) $\lambda \mathbf{t} \lambda \mathbf{p}$ [**p** is temporally located at **t**].

Equivalently we could say that we interpret (13) as the two-place-relation of being temporally located. The same considerations hold for embedded interrogatives.

(15)Max wonders what time it is (now).

A reasonable interpretation of (15) is the following.

(16) Max wonders $\lambda \mathbf{t} \lambda \mathbf{p}$ [**p** is temporally located at **t**].

(16) might roughly be the proposition which is true if Max is asking for a time **t** such that he truly self-ascribes the property $\lambda \mathbf{p}$ [**p** is temporally located at **t**].
By the same kind of reasoning we conclude that the (ii)-expression represents in each case the reasonable interpretation of the (i)-expression:

(17) i. Which mountain is this?
ii. $\lambda \mathbf{m} \lambda \mathbf{p}$ [**p** is referring to **m**].

(18) i. Who am I?
ii. $\lambda \mathbf{p_1} \lambda \mathbf{p_2}$ [$\mathbf{p_1} = \mathbf{p_2}$].

(19) i. Which place is this here?
ii. $\lambda \mathbf{l} \lambda \mathbf{p}$ [**p** is located at **l**].

In other words, all these interrogatives are interpreted as two-place relations.
"Which mountain is this?" is interpreted as "**p** is referring to **m**", "Who am I?" is understood as personal identity, "Which place is this here" (more dramatically: "Where is here?") is best interpreted as the relation of "being located at". It makes no sense to interpret these interrogatives according to standard semantics. We know this from the first paragraph. In all these cases, it is pretty obvious how we have to interpret the interrogatives.

Up to now, however, it is still a mystery what the relation between the surface syntax and our understanding is. There seems to be no obvious way to get the intended meanings from the expressions by means of the ordinary semantic techniques. Should we believe in a pre-established harmony between form an interpretation, then?

4. DO WE UNDERSTAND ESSENTIAL INDEXICALS BY DIAGONALIZATION?

I believe that an essential step toward a correct analysis of the problem is made in Stalnaker (1978). For reasons that will become clear later, we will call the interpretive method sketched by Stalnaker "diagonaliziation". Let me remark, however, that Stalnaker's diagonalization can't, as it stands, account for any of the sentences mentioned so far. This paper modifies his method so that its original deficiencies are overcome. I will say more about Stalnaker's original proposal at the end of this article. Let me expose now the idea of the diagonalization procedure.

We have argued that we sometimes interpret

(1) It is now 3.49 a.m.

as the property of being temporally located at 3.49 a.m.. How is this property obtained from (1)? Well, it is that property which is true of a person at a time **t** iff the following counterfactual conditional is true at **t**:

(2) If **p** were to utter (1), then **p** would express a true proposition by that utterance.

Call the procedure which abstracts this property from (1) **diagonalization over the actual speaker**. This diagonalization gives us the right property. Let us check that with some care. What we have to show is this.

(3) Let **p** be any person. Then **p** is temporally located at 3.49 a.m. iff (2) holds good.

Well, suppose **p** is temporally located at 3.49 a.m.. Imagine further that **p** did utter "It is now 3.49 a.m.." Then he would express the proposition that 3.49 a.m. = 3.49 a.m.. So what he would express would be true. So (2) holds good. Suppose, on the other hand, that (2) is true. Then **p** would express a true proposition if he uttered "It is now 3.49 a.m.".
So, obviously, **p** has to be temporally located at 3.49 a.m..

Let us consider our other examples.

(4) Here is Otaki Forks.

Diagonalization over the actual speaker gives us the property of being (spatially) located at Otaki Forks. We may describe this diagonalization in the following way:

(5) Let **P** be the property which is true of a person **xiff** the following condition holds:
If **x** uttered (4), then **x** would express a true proposition.

It can easily be verified that **P** is the property of being spatially located at Otaki Forks. Also for our example

(6) This is Mount Rollestone

diagonalization over the actual speaker gives us the right result, namely the property of referring to Mount Rollestone.

It is interesting to see that diagonalization over the actual speaker gives in each case a property of persons, though in none of the examples *I* or any other personal pronoun occurs. Obviously, this is so in virtue of the meanings of *now, here* and *this*. These are egocentric words meaning something like "the time at which I am", "the place where I am" and "the object I am referring to" respectively. Diagonalization over an actual speaker converts these meanings into "the place where **x** is", "the time at which **x** is" and "the object **x** is referring to". We can, of course, also perform the diagonalization procedure if we have to do with explicit egocentricity, **i.e.** if an *I* occurs in our sentence.

(7) I am not David Hume.

Diagonalization over the actual speaker applied to (7) gives us the property of being different from David Hume.

So there exists a procedure which in each of these cases accounts for an intuitive understanding in a fully systematic way.

It is possible to extend the method of diagonalization to a treatment of interrogatives which contain essential egocentric indexicals. Let us briefly show how this works.
Consider our standard example.

(8) What time is it now?

The construction of the "logical form" of (8) may be thought of as involving the following steps. We start from the "deep-structure" (9):

(9) It is now what time

The "logical form" of (9) is (10):

(10) now = **t**

with **t** ranging over times.
At this state we have to diagonalize over the actual speaker, thus obtaining the open property (11)

(11) λ**p** [the time where **p** is temporally located = **t**]

(11) is the interpretation which we obtain by means of diagonalization from (10), **i.e.** from the standard meaning of (9). We obtain (8) by *wh*-movement from (9). The semantic effect of *wh*-movement is just abstraction. So the semantics of *wh*-movement converts (11) into (12).

(12) λ**t**λ**p** [the time where **p** is temporally located = **t**]

From the preceding paragraph we know that this is the desired logical form for (8). It should be obvious that the other interrogatives which contain essential indexicals are to be treated analogously.

So diagonalization can explain our intuitive understanding in all the cases we have considered so far. Let us therefore ask the following question: Can we interpret every essential indexical by an appropriate diagonalization? The following examples seem to provide evidence for a negative answer to this question.

(13) Max believes that I am Ruth.

(14) Ruth believes that here is Totara Flats.

It is easy to see that indexicals in these *that*-clauses are essential. Each essential indexical is an egocentric word. But the diagonalization procedure which abstracts a property of persons of the *that*-clauses will give the wrong readings in both cases, namely (15) for (13) and (16) for (14).

(15) Max believes λ**p** [**p** = Ruth].

(16) Ruth believes λ**p** [the place where **p** is located = Totara Flats].

(15) means that Max believes that **he** is Ruth. But this is not what (13) means. (13) rather says that Max believes that **I** am Ruth. (16) means that Ruth believes that **she** is located at Totara Flats. This is not what (14) means. (14) expresses the proposition that Ruth believes that **I** am located at Totara Flats.
The method of diagonalization which we have introduced so far works only under the following condition:

(17) The subject is the first person and the *that*-clause contains an egocentric word.

It is possible to systematically construct examples of sentences which contain essential indexicals but which don't fulfil this condition. (13) and (14) were such cases. Another example is this:

(18) Lingens believes that **he** is David Lewis.

The *he* is an essential indexical but no egocentric word at al. The plausible reading of (18) is (19):

(19) Lingens believes λ**p** [**p** = David Lewis]

In order to obtain the property of being David Lewis from the *that*-clause in (18), we would have to define something like "diagonalization over the actual third person". This procedure should be equivalent with the usual λ-abstraction. Similarly, if we wanted to explain the plausible reading for (20), **i.e.** (21), we would have to work with something like "diagonalization over the actual addressee".

(20) Thou believest that thou art David Hume.

(21) Thou believest λ**p** [**p** = David Hume].

So we could perhaps also explain (18) to (21) by means of appropriate diagonalization procedures.
And, indeed, there **is** a way to make the object of belief informative even for the examples (13) to (20). But it is hard to explain this informally. I postpone a treatment of these examples to section 9 where a formal analysis of diagonalization will be given.

So let me leave the discussion of the diagonalization method at this stage. There is a more comprehensive method which can do everything diagonalization can and which can do even more. It's the theory of relational attitude. I would like to develop the leading ideas of this theory first. Later on I will compare the two approaches.

5. Essential indexicals and relational attitude

I think it is time to risk a thesis. It is this:
Essential indexicals are the symptoms for some relational attitude.

It is pretty obvious that any example discussed so far has a relational paraphrase. Consider the critical sentences (13) and (14) of section 4 here repeated as (1 i) and (2 i). Relational paraphrases of the intended readings are (1 ii) and (2 ii) and, perhaps, (1 iii) and (2 iii):

(1) i. Max believes that **I** am Ruth.
ii. Max believes of me that **I** am Ruth.
iii. Max believes of Ruth and me that we are the same person.

(2) i. Ruth believes that here is Otaki Forks.
ii. Ruth believes of the place where **I** am that it is Otaki Forks.
iii. Ruth believes of the place where **I** am and of Otaki Forks that they are one and the same.

Notice incidentally that the indexicals occurring in the *that*-clauses are essential again.

As for the readings expressed by the relational paraphrases, they are roughly the following ones. (1 ii) expresses the proposition that Max ascribes to me the property of being Ruth, and (1 iii) means that Max ascribes to Ruth and me the relation of being the same person. Similarly, (2 ii) expresses the proposition that Ruth ascribes the property of being Otaki Forks to the place where I am, whereas (2 iii) expresses the proposition that she ascribes of being the same place to the place where I am and to Otaki Forks. Let us represent these readings as (3)(i-ii) and (4)(i-ii) respectively.

(3) i. Max ascribes $\lambda \mathbf{p}[\mathbf{p}= \text{Ruth}]$ to me.
ii. Max ascribes $\lambda \mathbf{p_1 p_2}[\mathbf{p_1}= \mathbf{p_2}]$ to <Ruth, me>.

(4) i. Ruth ascribes $\lambda \mathbf{l}[\mathbf{l}= \text{Otaki Forks}]$ to here.
ii. Ruth ascribes $\lambda \mathbf{l_1 l_2}[\mathbf{l_1}= \mathbf{l_2}]$ to <here, Otaki Forks>.

These representations don’t say much before we know what ‚ascribes‘ exactly means. They do, however, symbolize the ‚relational‘ sense. The notion of ascription is a three-place relation. In (3 i), it relates Max, the property of being Ruth and me. In (3 ii), it relates Max, the property of being the same person and the pair consisting of Ruth and me. Similarly for (4). These examples also show that there is in general more than one relational paraphrase for a sentence involving essential indexicals.

There exist relational paraphrases for our diagonalizable examples, too.

(5) i. I believe that I am Ede.
ii. I believe of myself that I am Ede.
iii. I believe $\lambda \mathbf{p}\ [\mathbf{p} = \text{Ede}]$ of myself.
iv. I believe of Ede and myself that we are the same person.
v. I believe $\lambda \mathbf{p_1 p_2}[\mathbf{p_1}= \mathbf{p_2}]$ of <Ede, myself>.

These paraphrases show, that I take ' believe of ' and ' ascribe to ' to be synonyms.

Let us consider the relational paraphrase of an interrogative with an essential indexical.

(6) i. I wonder what time it is now.
ii. I wonder what time to ascribe to now.
iii. I wonder $\lambda \mathbf{t_1}$[I truly ascribe $\lambda \mathbf{t_2}$ [$\mathbf{t_1} = \mathbf{t_2}$] to now].

(6 iii) means that I am asking for some time such that I truly ascribe the property in some detail. I will follow the analysis given in Lewis (1979). Before starting, let me mention two points which this analysis should be compatible with.

First. The relational analysis of a sentence like (5 i) should provide a reading which makes it equivalent to the reading we get by means of diagonalization over the actual speaker, i.e. with (7):

(7) I self-ascribe $\lambda \mathbf{p}$ [$\mathbf{p}$ = Ede]

The same adequacy criterion holds for interrogatives whose interpretation can be explained by means of diagonalization: (6 ii) should have a reading which is equivalent to our diagonalization analysis (8):

(8) I wonder $\lambda \mathbf{t}$ [I truly self-ascribe $\lambda \mathbf{p}$ [the time when $\mathbf{p}$ is = $\mathbf{t}$]][6]

Second. The relation between syntax and semantics should, at least in principle, be clear. The relational ‚logical forms‘ of our sentences look quite different from their surface forms. A philosopher could say: I don't care, surface syntax is not my guide. A linguist can't adopt this attitude. Maybe, surface syntax is not his guide either, but syntax in some sense is his guide.

Let me now talk about relational belief. I will ignore attitudes other than belief. They can be analysed in an analogous way. For some more details, see Lewis (1979).
Lewis assumes the relation of **self-ascription** or **de se-belief** as a primitive:

(9) Person **x** self-ascribes **P,** where **P** is a one-place-property.

Notice that **de se**-belief can't always be reduced to propositional belief. Take Perry's famous example. I, seeing myself in the mirror without being aware that I am seeing myself. I say to myself:

(10) His pants are on fire.

I may believe (10) without believing (11):

(11) My pants are on fire.

If the object of belief were a proposition, I could not believe (10) without believing (11), because these sentences express the same proposition because his pants are my pants.
Notice, incidentally, that Stalnaker believes that every belief is propositional. He would presumably try to analyse (10) and (11) differently by means of an appropriate diagonalization procedure. I think that Stalnaker is wrong in this, but I don't want to give arguments for this view. I refer the reader to Lewis (1979).

[6] For the sake of parallelism with (6 iii), I have represented the diagonalization reading a bit differently from that found in the preceding sections.

Instead of using self-ascription as a primitive, we could also use a relation of doxastic alternativeness as an unanalysed concept. The intuitive sense of this relation may be described in the following way:

(12) **„Lewis-Alternativeness“:** **y** is a doxastic alternative of **x**, **xLy**, iff **x** might be **y** in view of **x's** actual beliefs, **i.e. y** satisfies every property which **x** self-ascribes.

The **L-**relation has to be considered as a primitive, of course. Once we have it at our disposition, we can define self-ascription:

(13) **x self-ascribes P iff** for any **y**: If **xLy**, then **P** is true of **y**.

Henceforth, you may regard either the notion of self-ascription or the **L**-relation as a primitive, whichever you prefer.

Our sentences which contain essential indexicals that can be explained by means of diagonalization all involve **de se-belief** (or another **de se**-attitude). For instance, the truth conditions of (14 i) can be formulated either as (ii) or as (iii) (under a non-trivial interpretation, of course).

(14) i. I believe that my pants are on fire.
ii. I self-ascribe λ**p** [**p**'s pants are on fire].
iii. (∀**x**)(**I L x** ⇒ **x**'s pants are on fire).

Notice that in view of definition (13), (14 ii) and (iii) mean exactly the same.

Relational belief or **de se-belief** is belief under a suitable description. Let us introduce the appropriate terminology for a special case.

(15) A person x ascribes property P to an object y under a description D (where D is a two-place relation) iff
(i) x bears D uniquely to y and
(ii) x self-ascribes the property of bearing D uniquely to something which has P.[7]

There is the following relationship between relational belief and **de se-belief**: Relational belief under a purely egocentric description becomes a **pure de se-belief**. The **purely egocentric descriptions** are these:
‚the person I am‘ (= I), ‚the time at which I am‘ (= now), and ‚the place where I am‘ (= here).

Let us consider two examples. We first show that (16) is equivalent to (17).

(16) I believe that λ**p** [**p** = Ede] of myself under ‚the person I am‘.

(17) I self-ascribe λ**p** [**p** = Ede]

---

[7] It might be useful to restate (i) and (ii) by means of some symbols and the **L**-relation:

$(\forall z)\ (D(x,z) \Leftrightarrow z = y)$

$(\forall u)\ (xLu \Rightarrow Q(u))$, where Q is the property which is true of any individual z iff

$(\exists u_1)\ [(\forall u_2)\ (D(z, u_2) \Leftrightarrow u_1 = u_2)\ \&\ P(u_1)]$.

‚The person I am‘ is taken in the sense where this term expresses personal identity, **i.e.** we diagonalize over the actual speaker.

Let us prove our claim: (16) holds good iff (i) $(\forall \mathbf{z})$ (I = **z**) $\Leftrightarrow$ **z** = I) and (ii) $(\forall \mathbf{u})$ (I **L u** $\Rightarrow$ **u** bears identity uniquely to something which is Ede), by definition (15).
This is equivalent to:
$(\forall \mathbf{u})$ (I **L u** $\Rightarrow$ **u** = Ede).
By (13), this holds iff (17) is true.

By an argument of the same kind we convince ourselves that (18 i) and (18 ii) are equivalent:

(18) i. I wonder λ**t** [I truly self-ascribe λ**p** [the time at which **p** is = t]
ii. I wonder λ$\mathbf{t_1}$ [I truly self-ascribe λ$\mathbf{t_2}$ [$\mathbf{t_1}$= $\mathbf{t_2}$] to now under ‚the time at which I am‘]

In (18 ii), the purely egocentric description is taken in the sense ‚being temporally located at‘. Furthermore, I am assuming that I denotes a time-slice of myself so that I am able to talk of **the** time at which I am.
Let's go through the argument.
(18 ii) is true
iff I am asking for some time $\mathbf{t_1}$ such that I truly ascribe λ$\mathbf{t_2}$ [$\mathbf{t_1}$= $\mathbf{t_2}$] to the time at which I am (=now) under the description ‚the time at which I am‘.
This is the case
iff I am asking for some time $\mathbf{t_1}$ such that
$(\forall \mathbf{t})$ (I bear ‚the time at which I am‘ to **t**) $\Leftrightarrow$ **t** = the time at which I am, **i.e.** now)
and $(\forall \mathbf{u})$ (I **L u** $\Rightarrow$ **u** bears ‚being temporally located‘ uniquely to some time which is $\mathbf{t_1}$)
iff I am asking for some time $\mathbf{t_1}$ such that
$(\forall \mathbf{u})$ (I **L u** $\Rightarrow$ the time at which **u** is $\mathbf{t_1}$)
iff I am asking for some time $\mathbf{t_1}$ such that
I truly self-ascribe λ**p** [the time at which **p** is t_1]
iff I wonder λ**t** [I truly self-ascribe λ**p** [the time at which **p** is = **t**]].
This finishes the proof.

Notice that a **de se**-belief which takes place under a description which is egocentric but not purely egocentric is not a pure **de se**-belief. Consider the following example.

(19) i. I believe this is David.

Think of a **de se**-analysis of the following sort:

(19) ii. I ascribe λ**p** [**p** = David] to this under ‚the object I am pointing at‘.

This is the proposition that [I am pointing uniquely to some object **and** I self-ascribe the property λ**p** [the object **p** is pointing at = David].
This proposition entails that I am pointing uniquely to some object. This information is not entailed by the reading we get from (19 i) by means of diagonalization:
(19) iii. I self-ascribe λ**p** [the object **p** is pointing at = David].
(19 iii) is what I would call a **pure de se-**analysis. So, in some cases there is a subtle difference between a relational analysis and an analysis **via** diagonalization. If we disregard this subtlety, our examples show, however, that **de se**-attitude is a special case of relational attitude. We don't

need diagonalization procedures in order to account for the essential indexicals. So we have fulfilled the first task which we wanted to accomplish this section.

On the other hand, there are sentences whose nontrivial readings presented difficulties for diagonalization. Let us return to them now.

(20) i. Max believes that I am Ruth.
ii. Max ascribes λ**p** [**p** = Ruth] to me.

(21) i. Ruth believes that here is Otaki Forks.
ii. Ruth ascribes λ**l** [**l** = Otaki Forks] to the place where I am.

(20) and (21) are our examples (1) and (2). The logical forms (ii) look incomplete. Relational belief takes place under a description. What time of description do we have to assume? Obviously, **purely** egocentric descriptions won't do in these cases, because (20) and (21) report **de re**-beliefs of Max and Ruth: Max believes something of me and Ruth believes something of the place where I am.

According to Lewis, a relational belief becomes **de re** if it takes place under a **relation of acquaintance**. A relation of acquaintance is expressed a suitable egocentric description, but this time the description need not be purely egocentric. I don't want to speculate what relations of acquaintance are in general – this is a very hard epistemological question – but I merely give some examples. Relations of acquaintance are the purely egocentric descriptions and relations like ‚the man I am seeing', ‚the person I remember as "Max Cresswell"', ‚the noise I am hearing', ‚the odour I am smelling', ‚the ice-cream I am tasting', ‚the stone I am touching'. Let us call any such descriptions which establishes a cognitive contact between an experiencer and an object **suitable**. We can then define **de re**-belief in the following way.

(22) De re-belief. A person x ascribes a property P to an object y iff x ascribes P to y under some suitable description.

Given this analysis, the logical forms (20 ii) and (21 ii) make sense.
Notice that according to our definition, every **de se**-belief is a **de re**-belief, whereas the opposite is not true in general.

Note one peculiarity of **de re**-belief. We have said that the indexicals occuring in (20) and (21) are essential, **i.e.** they can't be replaced by names. If the **de re**-account which we have given just before is correct, this claim can't be true. Obviously, the indexicals **I** and **here** in (20) and (21) stand in a transparent position. Therefore they can be replaced **salva veritate** by any terms denoting the same thing. This means that under a **de re**-reading, (20 i) and (21 i) are equivalent to (23) and (24) respectively.

(23) Max believes that Arnim is Ruth.

(24) Ruth believes that Konstanz is Otaki Forks.

This sounds paradoxical, but isn't really. The non-trivial readings of (23) and (24) are (25) and (26) respectively.

(25) Max ascribes λ**p** [**p** = Ruth] to Arnim.

(26) Ruth ascribes λ**l** [**l** = Otaki Forks] to Konstanz.

We must bear in mind that (23) and (24) is our way of reporting Max's and Ruth's **de re**-belief. If we asked Max "Do you believe that Arnim is Ruth" he would answer "No". He would perhaps report his **de re**-belief about me in the following way:

(27) The person standing over there in the shadow is Ruth.

But it happened to be the case that I was the person Max saw in the shadow. By the same kind of reasoning we convince ourselves that even in sentences reporting **de se**-beliefs the "essential indexicals" can be replaced **salva veritate** by names which have the same denotations.
For instance, (28 i) can be reported as (28 ii). The „logical form" of both sentences in their **de se**-reading is (28 iii).

(28) i. I believe that I am Ede.
ii. I believe that Arnim is Ede.
iii. Arnim ascribes λ**p** [**p** = Ede] to Arnim under ‚the person I am'.

Similarly, we can eliminate the essential indexicals from interrogatives which involve **de se**-attitudes.

(29) i. I wonder what time it is now.
ii. At 3.49 a.m., Arnim is wondering what time to ascribe to 3.49 a.m..
iii. At 3.49 a.m., Arnim is wondering λ$\mathbf{t_1}$ [Arnim truly ascribes λ$\mathbf{t_2}$ [$\mathbf{t_1}$ = $\mathbf{t_2}$] to 3.49 a.m. under ‚the time at which I am'].

Do these considerations show that there are no essential indexicals? In a way: yes, in another way: no.
The semantics which is given in this section says that there are no semantic reasons for having a concept like ‚essential indexical'. But there are pragmatic reasons for this notion. It is a pragmatic impossibility that I express my **de se**-belief (30 i) as (30 ii). A pragmatic possibility of expressing my belief is (30 iii).

(30) i. I self-ascribe λ**p** [**p** = Arnim].
ii. I believe that Arnim is Arnim.
iii. I believe that I am Arnim.

Similarly. It is pragmatically impossible to give words to my **de se**-wondering (31 i) by (31 ii). I rather have to say something like (31 iii).

(31) i. I wonder λ$\mathbf{t_1}$ λ**p** [the time at which **p** is = $\mathbf{t_1}$].
ii. I wonder what time to ascribe to 3.49 a.m..
iii. I wonder what time it is.

I conclude these observations by claiming that the notion of ‚essential indexical' is a pragmatic notion, not a semantic one. I will come to some pragmatic principles guiding our understanding of essential indexicals in the following section.

I think I have sufficiently defended my thesis that a theory of relational attitude can account for any kind of essential indexical. Let me therefore turn to the other problem mentioned above:

What is the relation between the syntax of sentences reporting a **de re**-attitude and their semantics?

In Stechow and Cresswell (1982) we have answered this question at least in principle. I don’t want to go into the details here, I only want to sketch the idea. As we have seen from the examples, a **de re**-attitude is basically a three-place relation involving a subject, a predicate and appropriate arguments. In the examples discussed so far, we had to consider only one-place predicates of first order. In the general case we have to consider multi-place higher-order predicates as well. In Stechow and Cresswell (1982) we give a procedure that splits up a that-clause into pairs $<\mathbf{P}, <a_1, ..., a_n>>$, where **P** is and n-place predicate and $a_1, ..., a_n$ are arguments of the right type. The general condition for assigning a *that*-clause a pair $<\mathbf{P}, <a_1, ..., a_n>>$ is this:
P applied to $<a_1, ..., a_n>$ yields the proposition which the *that*-clause expresses according to its syntax and standard semantics. It follows that, if a *that*-clause is assigned different pairs $<\mathbf{P}, <a_1, ..., a_n>>$ and $<\mathbf{Q}, <b_1, ..., b_k>>$, the these pairs are truth-conditionally equivalent, **i.e.** $P(a_1, ..., a_n)$ is the same proposition as $Q(b_1, ..., b_k)$.

Let us consider some examples.
If we ignore the descriptions under which a **de re**-belief takes place, we can represent different relational readings of (32 i) in the following way:

(32) i. Max believes that I am Ede.
ii. Max believes <λ**p** [**p** = Ede], **I**>.
iii. Max believes <λ**p** [**I** = **p**], Ede>.
iv. Max believes <λ$\mathbf{p_1 p_2}$ [$\mathbf{p_1}$ = $\mathbf{p_2}$], <I, Ede>>.
v. Max believes <λ**R** [I **R** Ede], = >, where **R** ranges over two place relations.
vi. Max believes <λ$\mathbf{p_1}$ **R** $\mathbf{p_2}$[$\mathbf{p_1}$ **R** $\mathbf{p_2}$], <I, Ede>>.

(32 iv) expresses, for instance, that Max ascribes personal identity to me and Ede. According to (32 v), he ascribes the higher-order property of being a relation which connects me and Ede to identity. All these readings are non-equivalent. We have to generalize (15) and (22), of course, in order to cover these cases as well.[8]
(ii) to (vi) are canonical representations of **de re**-readings. You may think of any pair $<\mathbf{P}, <\mathbf{a_1}, ..., \mathbf{a_n}>>$ as a Russell-Kaplan Donellan proposition, **i.e.** a structured proposition. Notice, however, that the structure is not motivated metaphysically but pragmatically. You may conceive of **P** as a

[8] The generalized definitions are these:

(15 G) A person **x** ascribes the **n**-place property **P** to $\mathbf{y_1}$,..., $\mathbf{y_n}$
under the descriptions $\mathbf{D_1}$, ...,$\mathbf{D_n}$ iff

a. **x** bears $\mathbf{D_i}$ uniquely to $\mathbf{y_i}$ (i = 1, ..., n) and

b. **x** self-ascribes the property of uniquely bearing $\mathbf{D_1}$,...,$\mathbf{D_n}$ to some n-tuple of things which satisfies **P**.

(22 G) A person **x** ascribes **P** to $\mathbf{y_1}$,..., $\mathbf{y_n}$
iff
x ascribes **P** to $\mathbf{y_1}$,..., $\mathbf{y_n}$ under an **n**-place sequence of suitable descriptions.

In Stechow and Cresswell (1981) an even more general definition is given. We require that the subject is also related to the property ascribed by a description. This generalization is needed for the explanation of tricky cases of mathematical belief, but it is not needed for the purposes of this paper.

question (the ‚topic‘), which the subject, the believer, answers by <$\mathbf{a_1}$, ..., $\mathbf{a_n}$> (the "foci‘". Vide for such an analysis of propositions Manor (1981a). The procedure which converts *that*-clauses into (finitely many) "logical forms" is very simple. It works more or less according to the following idea: Replace the expressions that will become ‚foci‘ by an appropriate variable which is bound by the λ-abstractor. The expression itself goes ‚to the right‘ into the ‚focus position‘. I hope that these remarks become clear if you have a look at the examples (32) again.
For details see the appendix.

I have said that we may conceive of the structured proposition which is the object of an attitude as a question together with an answer. I like this idea of Ruth Manor [9] and it is, indeed, one of the leading ideas which inspired this paper. However, this view raises an interesting problem for our examples. Consider my standard example again:

(33) I believe that I am Arnim.

The relational representation of a plausible reading of this sentence is the following:

(34) I believes <λ**p** [**p** = Arnim], I>.

If we assume that the ascription takes place under the description ‚the person I am‘, we obtain the right reading, the pure **de se**-reading. Now, if we identify the property contained in the structured proposition with a *wh*-question, we get something like this:

(35) I believe <Who is Arnim?, I>.

If we put this in plain words, it means something like ‚I am answering myself the question "Who is Arnim?" by "I"‘.
But this seems intuitively wrong. The question I am asking myself rather is "Who am I?" and my answer is "Arnim". So we would expect the following interpretation:

(36) i. I believe <Who am I?, Arnim>.
ii. I believe <λ**p** [**p** = I], >Arnim>.

This puzzle is only apparent. Under the description ‚the person I am‘, (35) and (36) mean exactly the same.
This leads us to question what the connection between the surface syntax of interrogatives and their plausible readings is. Consider the following sentence:

(37) Who am I?

Under a relational analysis, the plausible logical form is something like the following:

(38) $\lambda \mathbf{p_2} < \lambda \mathbf{p_1} [\mathbf{p_1} = \mathbf{p_2}]$, I>

If I ask you (38), you name me Arnim and I am happy with your reaction then I henceforth believe

(39) $\lambda \mathbf{p_2} < \lambda \mathbf{p_1} [\mathbf{p_1} = \mathbf{p_2}]$, I> applied to Arnim

[9] Manor (1981b)

But (39) is equivalent to (40):

(40) $<\lambda \mathbf{p_1}$ [Arnim = $\mathbf{p_1}$], I>

This is correct object for a relational belief. It becomes a pure belief **de me** if the ascription of the property $\lambda \mathbf{p_1}$ [Arnim = $\mathbf{p_1}$] to myself takes place under the description ‚the person I am‘. It is pretty obvious how to get (38) from the surface (37). Let me draw a picture which illustrates the translation process into the logical form.

(41) I am who

This is the "deep-structure" of (37). The "structuring rule", **i.e.** the rule which gives us a structured proposition , converts this into

(42) $<\lambda \mathbf{p_1}$ [$\mathbf{p_1}$ am who], I>.

Now we apply *wh*-movement and thus obtain

(43) $who_2 <\lambda \mathbf{p_1}$ [$\mathbf{p_1}$ am $\mathbf{t_2}$], I>

I have said in section 0 that *wh*-movement means just abstraction, *am* means identity. Therefore, (43) is the same as (38).
(t_2 is supposed to be a Chomskyan ‚trace‘. It is the bound variable ‚$\mathbf{p_2}$‘ and **who**$_2$ is ‚$\lambda \mathbf{p_2}$‘)

So it seems to be no problem to obtain the meaning of sentences containing essential indexicals from their surface syntax.

6. PRAGMATIC DISAMBIGUATION

How do we find out which reading is expressed by a sentence containing essential indexicals? There are no mechanical procedures for answering this question. But there are certain pragmatic principles that can help us here ("Gricean maxims"). One principle has to do with informativeness. It is in most cases reasonable to assume that a question or a reported belief is informative. It is mostly pointless to ask non-informative questions or to ascribe a non-informative property either to oneself or to something else.
What is informativeness?
Well, a proposition is informative if it is contingent. If we think of propositions as sets of possible worlds, then this happens to be the case if the proposition is different both from the set of all possible worlds and from the empty set, **i.e.**, the proposition is neither a tautology nor is it a contradiction. An analogous definition holds for properties. If we identify properties with the things satisfying them, then an informative property is satisfied by some but not all things.

Let us formulate a first pragmatic principle which helps us to choose the right interpretation for an utterance in the following way:

(1)Assume informativeness!

I want to illustrate the usefulness of this principle by means of some examples. In order to shorten the representation, let me introduce the following notational conventions. I use the subscripts **de me**, **de te**, **de se**, . . . for expressing pure **de se**–belief, i.e. self-ascription of properties. If I consider **de re**-belief **simpliciter**, I use no subscript. The intended reading is clear from the fact that the object is a structured proposition, then. If a relational belief takes place under one or more egocentric descriptions, I will use the subscript **sub me** for "under the description 'the person I am'", **sub te** for "under the desscription 'the person I am addressing'", **sub nunc** for "under the description 'the time at which I am'", **sub hic** for "under the description 'the place where I am'" and **sub hoc** for "under the description 'the object I am referring to'". Using this notation, I'll be able to compare the diagonalization method which yields a pure **de se**-belief with the relational analysis.

These are the examples.

(2) i. I believe I am Max.
ii. I believe$_{\text{de me}}$ I am Max
(= I self-ascribe $\lambda\mathbf{p}\ [\ \mathbf{p} = \text{Max}]$).
iii. I believe$_{\text{sub me}}$ $\langle\lambda\mathbf{p}\ [\ \mathbf{p} = \text{Max}], \mathbf{I}\ \rangle$.

A propositional belief would be uninformative. Therefore you have to go to a **de se**-reading (2 ii) or to a relational reading, **e.g**. (2 iii), if you want to be in conformity with principle (1). As we know from the preceding paragraph, (2 ii) and (2 iii) express the same proposition. A simple **de re** -analysis would have made the sentence informative, too:

(2) iv. I believe $\langle\lambda\mathbf{p}\ [\ \mathbf{p} = \text{Max}], \text{I}\ \rangle$.

It seems to me, however, that the relational belief is indeed **sub me** if I say sentence (2). It is natural that I conceive of myself as 'the person I am' if I say "I". The case might be a bit more complicated when Sitting Bull is speaking: he never says "I", at least not in the novels of Karl May.

Notice that the problem of interpreting a sentence with essential indexicals arises for the hearer only. The speaker knows, of course, what he wants to say.

(3) i. You think this is David.
ii. You think $\langle\lambda\mathbf{p}\ [\ \mathbf{p} = \text{David}], \text{this}\rangle$.

A **de re**-analysis makes your belief informative. A **de re**-belief takes place under **some** suitable egocentric description, but can we also say under which? Sometimes we can. Suppose I am, by saying (3 i), just reporting your previous utterance:

(4) i. I think this is David.

It is very plausible that this utterance of yours expresses a mere **de se**-belief, which you hold, **viz**. (4 ii) or (4 iii).[10]

(4) ii. I think$_{\text{de me}}$ this is David
(= I self-ascribe $\lambda\mathbf{p}[\mathbf{p}$ is referring to David]).
iii. I think$_{\text{sub hoc}}$$\langle\lambda\mathbf{p}[\mathbf{p} = \text{David}], \text{this}\ \rangle$.

[10] Remember that (4 ii) and (iii) are not exactly the same propositions. The self-ascribed property is, however, the same in both cases.

It is plausible that in this context, the proposition expressed by (3 i) is either (4 ii) or (4 iii). In other words, the plausible reading of (3 i) is represented either as (5 i) or (5 ii), both analyses involving the same self-ascribed property.

(5) i. You think$_{\text{de te}}$ this is David
(= You self-ascribe λ**p[p** is referring to David]).
ii. You think$_{\text{sub hoc}}$<λ**p[p** = David], this >.

The formalizations (5) are interesting because they involve a change of perspective. The ascription in (5 ii) takes place under the description 'the person I am referring to', but the ego is not the speaker, it's the addressee. By the same argument we can convince ourselves that (6 i) is sometimes adequately represented as (6 ii) or (6 iii), both representations being equivalent.

(6) i. You believe you are Max.
ii. You believe$_{\text{de te}}$ I am Max
(= You believe λ**p[p**= Max]).
iii. You believe$_{\text{sub me}}$ < **p[p**= Max], you>.

It is interesting to see that we have to choose a sort of <u>monologue inteneur</u> paraphrase in the case of (6 ii), if we want to get the right reading. The representation (6 iv) would give us the wrong reading:

(6) iv. You believe$_{\text{de te}}$ you are Max
(= You self-ascribe λ**p**[the person **p** is addressing = Max]).

In other words, (6 iv) means that you believe that you are addressing Max. Notice that the relational analysis doesn't have the problem which the diagonalization analysis encounters. It yields almost automatically the right structure.

(7) i. He believes that Otaki Forks is here.
ii. He believes that <λ**l[l** = Otaki Forks], here >.

Mostly, the plausible reading for (7 i) can't be obtained by diagonalization. We would get the wrong result if the believer were not at Otaki Forks. If he is at Otaki Forks, the diagonalization procedure gives a possible reading, **i.e.**, in this particular case the following two propositions might be the correct interpretations.

(7) iii. He believes$_{\text{sub hic}}$ that <λ**l[l** = Otaki Forks], here >.
iv. He believes$_{\text{de se}}$ that Otaki Forks is here.
(= He self-ascribes λ**p**[the place where **p** is = Otaki Forks]).

(8) i. I thought I was here (but I wasn't).

Prima facie, it looks as if no reinterpretation were needed in this case. If we interpret (8 i) literally, the that-clause means, perhaps, something like the proposition that Arnim is at Otaki Forks. (Never mind the past tense in the subordinate clause. I take this to be a case of **consecutio temporum**, i.e., the **that**-clause is interpreted tenselessly.)

I am, however, interested in a **de se-** or at least **de re**-reading of (8 i). The literal understanding of (8 i) leaves open the possibility that I thought that Arnim was here without being aware that I am Arnim. A **de re-**analysis gives us a plausible reading:

(8) ii. I thought <λ**p**[**p** is here], I>.

This is correct even if my relational belief takes place **sub me, i.e.,** it is a **de se**-belief. The diagonalization procedure, however, makes things trivial:

(8) iii. I thought$_{\text{de me}}$ I was here.
(= I self-ascribed λ**p**[**p** is at the place where **p** is])

The self-ascribed property is necessary and thus not informative. This is so because diagonalization affects every egocentric word in a sentence.
The same point can be made with the following sentence, Kaplan's favourite object of speculation:

(9) i. I believe I am here now.

Again, the literal understanding makes the object of belief informative. But it expresses no **de se-** belief. Diagonalization makes the belief trivial:

(9) ii. I self-ascribe λ**p**[At the time at which **p** is, p is located at the place where **p** is].

The following relational analyses report gradually less informative beliefs:
(9) iii. I believe <λ**p**[**p** is here now], I>.
iv. I believe$_{\text{sub me et nunc}}$ <λ**pt**[**p** is here at **t**], <I, now>>.
v. I believe$_{\text{sub me nunc et hic}}$ <λ**ptl**[**p** is at **l** at **t**], <I, now, here>>.

(9 ii) and (9 v) express the same proposition, **i.e.,** the belief is in both cases trivial.
Notice that for most of our examples we tacitly employed a second principle besides (1), which may be expressed in this way:

(10) Assume self-location into space, time and among things!

This principle wants to say that an interesting belief should be non-propositional. Propositional belief tells me nothing about myself. It tells me, in which world I live but not where I am, when I am or who I am. The personal belief which one should assume according to (10) takes place **sub me, nunc et hic**. Notice that propositional belief is **de se**-belief as well: it locates the believer into logical space, some set of possible worlds. A true propositional belief is, however, never personal: it is true of anyone living in the same world. I believe that I live in a world where Athens was defeated at 404 B.C.. This property which I self-ascribe is not my property only but yours as well: everyone in our world has it.
Propositional properties don't distinguish different world mates, non-propositional properties do. I believe that I live in Konstanz. Only some people have the property of living there. I believe that I am Arnim von Stechow, only one individual satisfies the property of being this man. It's my personal property.
We did apply principle (10) for the interpretation of (8) and (9). I should mention another principle which specifies (10).

(11) Assume attitude **sub me.**

In other words, when the word **I** occurs in the **that**-clause, it is plausible to assume that I have, among others, an attitude to myself under the description 'the person I am'. This principle makes the following readings of (8) and (9) marginal:

(8) iv. I thought <λ**l**[I am at **l**], here>.

(9) vi. I believe$_{\text{sub hic}}$ <λ**l**[I am at **l** now], here>.
vii. I believe$_{\text{sub nunc}}$ <λ**t**[I am here at **t**], now>.

Let us see why these readings are not plausible. Consider, for instance, (9 vi). Let us assume that this is the proposition that Arnim self-ascribes the property λ**p** [Arnim is at 3.49 a.m. at place where **p** is] . ((9 vi) is this proposition, if (9) is uttered by myself at 3.49 a.m., provided we interpret (9) according to a relational analysis **sub hic**.) According to this analysis, I can self-ascribe this property without self-ascribing being Arnim, **i.e.** I may believe that I am at 3.49 a.m. at the same place where Arnim is without believing that I am Arnim. This doesn't seem plausible. Such readings are barred by (11).
Let me stop here trying to discover further principles which help us to disambiguate between several possible readings. It's enough to see that such principles exist. Let me rather consider an unsolved puzzle noticed by George Lakoff in Lakoff (1972)[p. 639].

(12) I dreamt that I was Brigitte Bardot and I kissed me.

There are several problems with this sentence. One is, that a propositional analysis of the traditional kind can never make the **that**- clause which reports my dream informative.
If we assume the standard semantics for "I", the **that**-clause must be the impossible proposition, because there is no possible world where Arnim von Stechow is Brigitte Bardot. This is our old problem, of course (though not stated in this form by Lakoff). Another problem, noticed explicitly by Lakoff, is this.
The embedded sentence

(13) I kissed me

is bad in isolation (since **me** is in a "disjoint reference" position, as Noam Chomsky would say, **vide** Chomsky (1977) [p. 179ff.]). As a part of (12), (13) seems, however, to be acceptable. How can we explain this?
An answer is difficult, because it is not so clear whether "to dream" is an attitude-verb of the same kind as "to believe" or "to wish". If it is, then the present approach lends itself to a solution of the following kind.
Let us say that the individual **y** is a **dream-alternative** of **x** iff **y** has every property **x** dreams to have.
Let us further say that **x** dreams a property **P** of **y** under description **D** (**x dreams** $_{\mathbf{D}}$ < **P**, **y**>) iff **x** bears **D** uniquely to and (∀**z**)(If **z** is a dream- alternative of **x**, then **z** bears **D** uniquely to something which has **P**). This analysis can be generalized for relational dream involving an **n**-place property and **n res**..
If this makes sense, then (12) could be analyzed in the following way.

(14) I dreamt$_{\text{sub me et me}}$ <λ$\mathbf{p}_1\mathbf{p}_2$ [$\mathbf{p}_1$ is Brigitte Bardot and $\mathbf{p}_2$ kisses me], <I,I>>

(14) is the proposition which is true **iff** [Arnim = Arnim **and** every dream-alternative of Arnim is identical with something $\mathbf{p}_1$ and also with something $\mathbf{p}_2$ such that $\mathbf{p}_1$ is Brigitte Bardot and $\mathbf{p}_2$ kisses Arnim]. The latter holds good **iff** every dream-alternative of Arnim is Brigitte Bardot and kisses Arnim.
It seems to me that this is an attractive result. Notice that the following "logical form" of (12) is equivalent to (14):

(15) I dreamt$_{\text{sub me}}$ <λ**p**[**p** is Brigitte Bardot and **p** kisses me], I>.

I discussed (14), however, because, according to the procedure I have in mind, which converts (12) into its "logical forms", (14) is closer to the surface. (**Vide** the appendix.)
If we were to introduce, in analogy to **de se**-belief,a notion of **de se**-dream, the object of my **de se**-dream reported by (15) (and hence by (14), too) would be the property

(16) λ**p**[**p** is Brigitte Bardot and **p** kisses Arnim].

Clearly, this property is informative. So we have solved our first problem and are in agreement with our principles "Assume informativenes! " and "Assume attitude sub me!".
Let us come to our second problem, the question why (13) is good as a part of (12). Well, have a look at the "logical forms" of (13), viz. (14) and (15). Neither (14) nor (15) contains (13) as a proper subpart. (14) and (15) contain the abstracts (17) and (18) respectively:

(17) λ$\mathbf{p}_1\mathbf{p}_2$ [$\mathbf{p}_1$ is Brigitte Bardot and $\mathbf{p}_2$ kisses me]

(18) λ**p**[**p** is Brigitte Bardot and **p** kisses me]

In both cases the "I" of (13) is replaced by a bound variable, viz. $\mathbf{p}_2$ and **p**. Neither $\mathbf{p}_2$ nor **p** denotes something, so no problem of "disjoint reference arises.
Everything I have said in this paragraph is very tentative. Be that as it may, I think that the treatment of these examples shows the expressive power of the Lewis-semantics for attitudes.

7. SYNTAX AND SEMANTICS OF λ-CATEGORIAL LANGUAGES

Up to now, I have tried to avoid any unnecessary technicalities. I don't care how you formalize what I have said so far. It is important to see, however, that it can be formalized. I take the simplest formal language which comes rather close to natural language, namely a λ-categorial language in the sense of Cresswell (1973). You may conceive of λ-categorial expressions as "logical forms" of surface sentences.

(1) A λ-categorial language is based on a system of **syntactic categories**. This set, **Syn**, is defined as the smallest set such that

S 1. $\{\mathbf{N}, \mathbf{CN}, \mathbf{S}\} \subset \mathbf{Syn}$

S 2. If $\tau, \sigma_1, ..., \sigma_n \in$ **Syn**, then $(\tau/\sigma_1, ..., \sigma_n) \in$ **Syn.**

S is the category of **sentence**, **N** is the category of **name** and **CN** is the category of **common noun**.
$(\tau/\sigma_1, ..., \sigma_n)$ is the category of a **functor** which makes an expression of category τ out of expressions of categories $\sigma_1, ..., \sigma_n$. For each category σ there is a finite set, $\mathbf{F}_\sigma$, of **symbols** of category σ. All but finitely many of these are empty. For each σ, there is a denumerably infinite set $\mathbf{X}_\sigma$ of **variables** of category σ. None of these sets, of course, must overlap.
With each σ we define the set $\mathbf{E}_\sigma$ of **expressions of category** σ as follows.

(2) **E** is the smallest system of sets such that

E 1. $\mathbf{F}_\sigma \subset \mathbf{E}_\sigma$

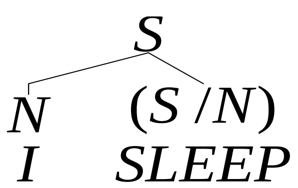
E 2. $\mathbf{X}_\sigma \subset \mathbf{E}_\sigma$

E3. If $\delta \in \mathbf{E}_{(\tau/\sigma(1),,..., \sigma(n))}$ and $\alpha_1, ..., \alpha_n$ are in $\mathbf{E}_{\sigma(1)} ..., \mathbf{E}_{\sigma(n)}$,respectively, then $\langle\delta, \alpha_1, ..., \alpha_n\rangle \in \mathbf{E}_\tau$.

E4. If $\alpha \in \mathbf{E}_\tau$ and $\mathbf{x}_1, ..., \mathbf{x}_n$ are in $\mathbf{X}_{\sigma(1)}, ..., \mathbf{X}_{\sigma(n)}$, respectively, then $\langle\lambda, \mathbf{x}_1, ..., \mathbf{x}_n, \alpha\rangle \in \mathbf{E}_{(\tau/\sigma(1),,..., \sigma(n))}$.

An expression beginning with a λ is called an **abstract** and λ is called the **abstraction operator**. It is a syncategorematic symbol , not in any syntactic category.
These rules can be illustrated by the following examples. Suppose that intransitive verbs like SLEEP make sentences out of names. This means that they are in the category (**S/N**). Suppose further that **I** is a name, viz. that it is of category **N**. By E 3, then, we have the sentence <SLEEP, I> in category **S**. Since it is clear which is the functor and which the 'argument' of the functor, we can reverse the order and allow <I, SLEEP> , vide Cresswell (1973). An equivalent "tree representation" is the following:

(3)



Let us abbreviate (**S/N**) as **IV**. Let us further assume that WANT is in category (**IV/IV**), i.e. it is an intransitive verb modifier and that the complex expressions TO SLEEP and AM TIRED are **IV**s. Finally, let AND be an (**S/S,S**). So

(4) <<I, AM TIRED>, AND, <I, <WANT, TO SLEEP>>>

is also a sentence.
Where **x** is a variable of category **N** and α is a sentence (= is of category **S**), then $\langle\lambda,x,\alpha\rangle$ means 'is an **x** such that α' . Thus we form

(5) <λ,x,<<AM TIRED, **x**> , AND,<<WANT, TO SLEEP>, **x**>>>

This abstract means 'am tired and want to sleep' (i.e. is an **x** such that **x** is tired and **x** sleeps). By E 4 it is of category (**S**/**N**). So

(6) <I,< λ, **x**, <<AM TIRED, **x**>, AND,<<WANT, TO SLEEP>, **x**>>>>

means that I am tired and want to sleep and is equivalent to (4). A particularly important category is the category (**S**/(**S**/**N**)) of nominals . Let us abbreviate (**S**/**(S**/**N**)) as **NP**. A symbol of this category is SOMEONE . So we can combine SOMEONE with (5) to get a sentence:

(7) <SOMEONE,< λ, **x**,<<IS TIRED, **x**> , AND,<<WANTS, TO SLEEP> ,**x** >>>>

(Never mind that I have brought the verb forms into agreement with the subject. I will always do so in order to avoid too much solecism.) Obviously, an **NP**, i.e. an (**S**/**(S**/**N**)) takes an (**S**/**N**) to form a sentence. In (6), an (**S**/**N**) combines with an **N** to form a sentence. In that case we have an equivalence between (4) and (6). The reason why SOMEONE cannot be an **N** is that (7) is not equivalent to

(8) <<SOMEONE, IS TIRED>, AND,<SOMEONE,< WANTS, TO SLEE>>>

(7) requires, while (8) does not, that the same person is both tired and wants to sleep.

Let me introduce the necessary semantic notions now.
We assume that we are given a set **W** of possible world histories. The numbers of **W** will be called **possible worlds**, for short. Let **T** be the set of time intervals.

(9) A **proposition** is a subset.of **W**×**T**. The proposition **p** is true in a world **w** at time **t** if <**w,t**> ∈ **p**; otherwise **p** is false in **w** at **t**.

We assume further that we are given a set **A** of possible things, the individuals proper. In this paper, I am adopting a haecceitistic view, i.e. I am assuming that an individual may live in more than one possible world. David Lewis is an anti-haecceitist and, indeed, most of the following definitions would become simpler, if we adopted his ontology. The reason why I am not following him in this respect is a purely pragmatic one: most linguists are acquainted with Montague's ontology only, and there you find haecceitism.

(10) An **n-**place property ω of individuals is a (partial) function from $\mathbf{A}^{\mathbf{n}}$ into the set of propositions.
ω is **true** of ($\mathbf{a}_1,\ldots,\mathbf{a}_n$) in the world **w** at the time **t** iff $<\mathbf{w,t}> \in \omega(\mathbf{a}_1,\ldots,\mathbf{a}_n)$.

If ω is an **n**-place property, let **sat(ω)** be the set of those $<\mathbf{w}, \mathbf{t}, \mathbf{a}_1,\ldots,\mathbf{a}_n>$ that satisfy ω, i.e. : $\{<\mathbf{w}, \mathbf{t}, \mathbf{a}_1,\ldots,\mathbf{a}_n> : <\mathbf{w},\mathbf{t},> \in \omega(\mathbf{a}_1,\ldots,\mathbf{a}_n)\}$. We can identify propositions with 0-place properties. Obviously, sat(**p**) = **p**, where **p** is a proposition.

(11) i. The property ϖ_1 **entails** the property ϖ_2 iff $\mathbf{sat}(\varpi_1) \subseteq \mathbf{sat}(\varpi_2)$
ii. ϖ is **informative** iff $\emptyset \neq \varpi \neq W \times T \times A^n$, where ϖ is an **n**-place property (n≥0).

The next thing we assume is a **system of semantic domains D.**

(12) **D** is a function from the syntactic categories which meets the following conditions:

D1. $\mathbf{D_S}$ is the set of propositions, i.e. the power set of $\mathbf{W}\times\mathbf{T}$.

D2. $\mathbf{D_N}$ is the set of things. It includes everything that can be named, i.e. we require $(\mathbf{A}\cup \mathbf{D}_\sigma) \subseteq \mathbf{D}_N$ for any σ.

D3. $\mathbf{D_{CN}}$ is a set of properties of things (i.e., the arguments of the properties are not necessarily in **A**; they may be in $\mathbf{D_N}$ quite generally.)

D4. $\mathbf{D}_{(\sigma/\tau(1),,\ldots,\ \tau(n))}$ is a collection of (partial) functions from $\mathbf{D}_{\tau(1)}\times\ldots\times\mathbf{D}_{\tau(n)}$ into $\mathbf{D}_\sigma$.

The elements of $\mathbf{D}_{(\sigma/\tau(1),,\ldots,\ \tau(n))}$ usually have to be partial, because $\mathbf{D}_{(\sigma/\tau(1),,\ldots,\ \tau(n))} \subseteq \mathbf{D}_N$.
If e.g. one of the τ_i is **N**, then $\mathbf{D}_{(\sigma/\tau(1),,\ldots,\ \tau(n))}$ can't contain any function which is an argument of itself.
A note on the policy of working with partial functions. Most Montagovians presumably don't like the idea that I don't say what exactly is in the semantic domains. In Montague Grammar you mostly work with total functions and define your domains exactly. I see no reasons for doing so.. It will become clear from the meaning rules we will give subsequently which functions we assume to be in the semantic domains. I am a strict follower of Cresswell (1973), in this respect. The advantages of this approach are obvious from numerous writings of Cresswell and other people, including the author of this paper. If someone thinks that this approach is not viable, he should give a reason for this opinion. I am not aware of any argument for such a view.
If we adopt the terminology of Kaplan (1977), we can call the elements contained in the semantic domains **contents**. We know that sentences have a content in general only with respect to a **context of use.** What is a context of use? In an anti-haecceitistic framework the answer is very simple: It is the time-slice of a (world-bound) individual, an **ego**. If we are given an **ego**, the other features which might be important for the determination of the deictic words can be detected: the world of the **ego**, the time at which it is, the place where it is and so on. (Vide Lewis (1981). Since we are adopting a haecceitistic view in this paper, we don't have world-bound individuals. We have to identify the context with a pair <**a,w**> , where **a** is the time-slice of an individual and w is a world. Using the terminology of Quine we may call such a pair a **centered world**. If we don't consider time-slices of individuals, we have to say that a context (an **ego**) is a 'triple <**a,w,t**> , where **a** is an ordinary individual , **w** is a world and **t** is a time. Notice that not any such triple is a **realizable context**. Take for instance the triple <Julius Caesar, the actual world, the present time>. This is a **counterfactual context**, since Julius Caesar died on the Ides of March, 44 B.C. Utterance contexts have to be realizable ones, of course.
It will be seen, however, that the operation of diagonalization requires counterfactual contexts.
Kaplan calls functions from contexts into contents **characters**. I will adopt this terminology, too. I will assume that characters are partial functions, and I will justify this assumption later on.

(13) A **character** is a partial function from the set of contexts into $\mathbf{D}_N$

Notice that $\mathbf{D}_N$ is so big that it contains virtually everything. In this paper, however, I need only very special characters, namely:

(i) **propositional-characters** (functions from the **ego's** into the propositions), call them **S-characters**
(ii) one-place-**property-characters** (functions from the **ego's** into the one-place properties), call them **CN**-characters.
(iii) I will call the (partial) functions from contexts to $\mathbf{D}_N$ **individual-characters** or **N**-characters.

Notice that the term 'individual-character' might be a misnomer, because **every** character is an individual-character according to the definition of $\mathbf{D}_N$. (It's like in set-theory where higher-order sets are also considered as individuals. It's **not** like in usual Montague-Grammar, because not everything is in Montague's $\mathbf{D}_e$ In the text, we will, however, mostly consider 'ordinary' individual characters, i.e. functions from contexts to **A**.
We are now ready to say what **meanings** are.

(14) A **system of meanings** is a function **M** from the categories which meets the following conditions.

MI. $\mathbf{M}_S$ is a set of **S**-characters.

M2. $\mathbf{M}_N$ is a set of **N**-characters.

M3. $\mathbf{M}_{CN}$ is a set of **CN**-characters.

M4. $\mathbf{M}_{(\sigma/\tau(1),,\ldots,\tau(n))}$ is a set of (partial) functions from $\mathbf{M}_{\tau(1)}\times\ldots\times\mathbf{M}_{\tau(n)}$ into $\mathbf{M}_\sigma$

Notice that according to this definition, not every meaning is a character, for instance an **(S/N)**-meaning is not: it takes an **N**-character and yields an **S**-character. In this respect, I deliberately depart from Kaplan (1977) who doesn't embed characters. But my semantics is in agreement with Cresswell (1973) or Klein (1980).

We assume that we have a family **Ass** of variable assignments.

(15) For each $\mathbf{x} \in X_\sigma$ and $\nu \in$ **Ass**, $\nu(\mathbf{x}) \in \mathbf{M}_\sigma$.
Furthermore, we require that $\nu(\mathbf{x})$ is a constant character, if $\sigma \in \{S,N,CN\}$.

(16) A meaning assignment is a function **V** such that where $\alpha \in \mathbf{F}$ then $\mathbf{V}(\alpha) \in \mathbf{M}_\sigma$.

We are now in a position to define an **interpretation** $\mathbf{V}_\nu$ for every expression.

(17) Let α be any expression.

V1. If $\alpha \in \mathbf{F}_\sigma$, then $\mathbf{V}_\nu(\alpha) = \mathbf{V}(\alpha)$

V2. If α is an $\mathbf{x} \in X_\sigma$, then $\mathbf{V}_\nu(\mathbf{x}) = \nu(\mathbf{x})$

V3. If $\alpha = \langle\delta, \alpha_1, \ldots, \alpha_n\rangle$, then $\mathbf{V}_\nu(\alpha) = \mathbf{V}_\nu(\delta)(\mathbf{V}_\nu(\alpha_1), \ldots, \mathbf{V}_\nu(\alpha_n))$
(Where this is undefined, so is the value of the expression.)

V4. If $\alpha = \langle\lambda, \mathbf{x}_1, ..., \mathbf{x}_{n,\beta}\rangle$ with $\mathbf{x}_1, ..., \mathbf{x}_n$ in $\mathbf{X}_{\sigma(1)}, ..., \mathbf{X}_{\sigma(n)}$ respectively and β in E_τ, then $\mathbf{V}_\nu(\alpha)$ is the function ϖ (provided it is in $\mathbf{M}_{(\tau/\sigma(1),,..., \sigma(n))}$)such that for any $\langle\mathbf{a}_1, ..., \mathbf{a}_n\rangle$ in $\mathbf{M}_{\sigma(1)}\times...\times\mathbf{M}_{\sigma(n)}$, $\omega(\mathbf{a}_1, ..., \mathbf{a}_n) = \mathbf{V}_{\nu(a(1)/x(1),...,a(n)/x(n))}(\beta)$. (If ω is not in $\mathbf{M}_{(\tau/\sigma(1),,..., \sigma(n))}$ or $\langle\mathbf{a}_1, ..., \mathbf{a}_n\rangle$ is not in the domain of ϖ, then the abstract is undefined.)

Let **c** be a context, i.e., an **ego** and let α be a sentence. We say:

(18) i. $\mathbf{V}_\nu(\alpha)$ (**c**) is **true in a world w** at time **t** iff $\langle\mathbf{w,t}\rangle \in \mathbf{V}_\nu(\alpha)$ (**c**).

ii. α is true with respect to **c** iff $\mathbf{V}_\nu(\alpha)$ (**c**) is true in the world of **c** at the time of **c**.

(18)i. concerns the truth of the proposition expressed at **c** in any world whatsoever, whereas (ii) defines the truth of the sentence with respect to the utterance context.

8. MEANING RULES FOR SOME INDEXICALS

The great majority of words are indexicals if we understand this term as denoting those words whose content changes with the context of use. It is generally accepted that pronominals are indexicals, but I also hold the view that verbs and common nouns can be indexicals. I will comment on this opinion as soon as we come to the examples.

In this section, I will give the meaning rules of words which play a role for the subsequent discussion. I will use the following notational conventions. I will represent the interpretation function **V** as | |. If an expression contains no free variable, I will ignore the relativization to a variable assignment ν). Remember that a context **c** is a triple $\langle\mathbf{a,w,t}\rangle$, where **a** is a person, **w** a world and **t** a time. I will write $\mathbf{a}_C$ for the first component of **c**, i.e., for **a**. Similarly, $\mathbf{w}_C = \mathbf{w}$ and $\mathbf{t}_C = \mathbf{t}$.

Let us analyse the meaning of the following sentence.

(1)

S
N (S /N)
I AM TIRED

(2) $|\mathrm{I}|c = \mathbf{a}_C$, for any context **c**

This rule captures Kaplan's intuition that **I** is "directly referential": this word directly denotes an individual, i.e. not via the mediation of a concept.

(3) |AM TIRED| is that function ω in $M_{(\mathbf{S/N})}$ such that for any $\iota \in \mathbf{M_N}$ and any correct c.

(i) $\varpi(\iota)(\mathbf{c})$ is defined only if $\iota(\mathbf{c})$ is an animate being in $\mathbf{w_C}$. For any ι and **c** that meet this condition:

(ii) $\varpi(\iota)(\mathbf{c}) = \{\langle w,t\rangle : \iota(\mathbf{c})$ is tired in **w** at $\mathbf{t_C}\}$.

Let us see what these rules mean for the evaluation of (1). Suppose I utter (1) now, i.e. **c** = <Arnim, the best of all possible worlds, the actual time>. According to (V3),

|<I, AM TIRED> |**c** = |AM TIRED |(|I |)**c.**

By (3 i), this is defined iff (|I |)**c** is an animate being (in the actual world). Since I am (|I |)**c** this must be so, otherwise I could not write this. We therefore can proceed to (21 ii) and obtain:

|AM TIRED |(|I |)**c** = {<**w,t**> : Arnim is tired in **w** at $\mathbf{t_C}$}.

Thus, with respect to **c**, (3) expresses the proposition that Arnim is tired at the actual time.

A remark on the format of my meaning rules. (3 i) imposes a restriction on the context. If this restriction is not met, the sentence will express no proposition. In Stechow (1981b), I have called such conditions to be met by the context **contextual presuppositions**. So, sentence (1) contextually presupposes that I am an animate being. This information, however, is not necessarily contained in the content. A similar idea can be found in Enç (1981).

Notice that the finite verb is an indexical, too. AM TIRED is analysed as the property of being tired at $\mathbf{t_C}$ This is not a serious analysis of the present tense, since it doesn't allow e.g. for a combination of the verb with temporal adverbs like **now** or **today** and frequency adverbs like **twice**. A serious analysis of tense is found in Bäuerle (1979), Kratzer (1978), Stechow and Bäuerle (1980).

Let me consider next a more complicated sentence.

(4) <I, <WANT, TO BE TIRE>>

Let us assume that TO BE TIRED means the same as AM TIRED. This is not entirely correct, because the infinitival is tenseless.

(5) WANT is an (IV/IV).
|WANT| is that function ϕ in $\mathbf{M}_{(IV/IV)}$ such that for any $\iota \in \mathbf{M_N}$, $\omega \in \mathbf{M_{IV}}$ and any context **c**:

(i) $\phi(\varpi)(\iota)(\mathbf{c})$ is defined iff $\varpi(\iota)(\mathbf{c})$ is defined.
For any such $\varpi,\iota,\mathbf{c}$ and any world **w** and time **t**:

(ii) <**w,t**> $\in \varphi(\varpi)(\iota)(\mathbf{c})$ iff for any <b,**w',t'**>: [**If** <b,**w',t'**> satisfies every property which ι(c) wants to have in **w** at $\mathbf{t_C}$ **then** <**w', t'**> $\in \omega(\iota_\mathbf{b})$] where $\iota_\mathbf{b}$ is the constant **N**-character which assigns **b** to every context **c**.

According to this analysis, |(4)| (**c**) = { <**w',t'**> : ($\forall$<b,**w',t'**>) (<b,**w',t'**> is a buletic alternative of (<$\mathbf{a}_C$,**w,t**> $\Rightarrow$ **b** is tired in **w'** at $\mathbf{t}_C$) } **.**

Notice that the contextual presupposition (5 i) might be too strong. But this is a detail which can be easily accommodated. Besides this, the proposition expressed by (4) at **c** seems to be the intuitively correct one.

Let us turn to some other indexicals now.

(6) $|\text{THOU}|\,\mathbf{c}$ is defined only if $\mathbf{a}_C$ addresses exactly one person in $\mathbf{w}_C$ at $\mathbf{t}_C$. For any such $\mathbf{c}$, $|\text{THOU}|\,\mathbf{c}$
is that person.

(7) $WE_{\mathbf{n}}$ is of category **N**, for any number **n**. $|WE_n|$ is that **N**-character ι such that for any **c**:

(i) (c) is defined only if $\mathbf{a_C}$ is referring in $\mathbf{w_C}$ at $\mathbf{t_C}$ by "WE_n" to exactly one set of individuals which includes himself.
(ii) For any **c** in the domain of ι, ι(**c**) is that set.

The numeric subscripts are needed in order to distinguish different occurrences of WE. That the speaker refers to some group by "$WE_{\mathbf{n}}$" means that (s)he produces a token of WE and has the intention of referring to that group by doing so. A more refined rule for WE, which accounts for the possibility that WE is uttered by more than one speaker, is given in Stechow and Kratzer (1977).

Notice that $|WE_{\mathbf{n}}|\mathbf{c}$, if defined, is an **N**-character which gives us a set. **N**-characters are functions from the contexts into $D_{\mathbf{N}}$. How do we know that $D_{\mathbf{N}}$ contains sets? Suppose I want to use WE_n in order to refer to Max and myself, i.e. to the set {Max,Arnim}. This set contains only individuals proper, i.e. it is a subset of **A**. Consider the following property ω: ω is defined for persons. For any **u** in the domain of ω, and any world-time $<w,t>$: $<w,t> \in \varpi(\mathbf{u}) :\Leftrightarrow \mathbf{u} \in$ {Max, Arnim}. So ω characterizes exactly {Max, Arnim}. Obviously, we can characterize any set of individuals proper in this way. Let us assume that $D_{\mathbf{N}}$ contains the properties of this kind. Let us further assume that $|WE_n|\mathbf{c} = \omega$**.** We have to say what it means that a character like |ARE TIRED| applies to such a property:

(8) |ARE TIRED| (ϖ)(**c**), if defined, is the proposition **p** such that for any$<\mathbf{w,t}>$:
$<\mathbf{w,t}> \in \mathbf{p}$ iff $(\forall u)(<\mathbf{w,t}> \in \varpi(\mathbf{u}) \Rightarrow \mathbf{u}$ is tired in **w** at $\mathbf{t_C}$).

According to this meaning rule, the sentence

(9) <WE_n, ARE TIRED>

expresses the proposition that Max and I are tired at $\mathbf{t}_C$, provided that $|WE_n|\mathbf{c}$ is the property ϖ mentioned . The meaning rule (7) is to be understood in this sense.

Obviously, there exist systematic connections between singular and plural. I am not going into this, here. Cf.,(Stechow (1980) for a detailed account.) Furthermore, not every plural property is "distributive", like ARE TIRED ; for instance, 'being tired of each other' is not. The point I wanted to make here is that a Cresswellian ontology is rich enough to handle such examples.

Let us go on with the meaning rules for indexi cal 5

(10) $THIS_{\mathbf{n}}^{\mathbf{N}}$ is an **N**, for any number **n**.
$|THIS_{\mathbf{n}}^{\mathbf{N}}|$ is that **N**-character ι such that for any **c**:
(i) ι(**c**) is defined only if $\mathbf{a_C}$ is referring in $\mathbf{w_C}$ at $\mathbf{t_C}$ by "$THIS_{\mathbf{n}}^{\mathbf{N}}$ " to exactly one individual.
(ii) For any such **c** , ι(**c**) is that individual.

As in rule (7), I need different subscripts in order to distinguish different occurrences of THIS. The superscript **N** is needed to distinguish the nominal THIS from the demonstrative article THIS, which will be treated subsequently.

(11) IS is an (**IV/N**).
For any $\iota_1, \iota_2 \in$ $\mathbf{M_N}$ and any **c**:

(i) $|IS|(\iota_2)(\iota_1)(\mathbf{c})$ is defined only if $\iota_1(\mathbf{c})$ and $\iota_2(\mathbf{c})$ are defined.
(ii) For any such **c**, $|IS|(\iota_2)(\iota_1)(\mathbf{c}) = \{<\mathbf{w,t}>: \iota_1(\mathbf{c}) = \iota_2(\mathbf{c})\}$.

(12) $MAX_{\mathbf{n}}$is an **N**, for any number **n**. $|MAX_{\mathbf{n}}|\mathbf{c}$ is defined only if "$MAX_{\mathbf{n}}$ " refers to exactly one individual in $\mathbf{w_c}$ at $\mathbf{t_c}$. Forany such **c**, $|MAX_{\mathbf{n}}|\mathbf{c}$ is that individual.

Let us apply this.

(13) <$THIS_1^N$, <IS, MAX_2>>
$|(13)|\mathbf{c}$, if defined, is the proposition {**w**: The object referred to by $\mathbf{a_c}$ in $\mathbf{w_c}$ at $\mathbf{t_c}$ by "$THIS_1^N$" = the object referred to by "MAX_2" in $\mathbf{w_c}$ at $\mathbf{t_c}$}. Let us assume for the sake of later reference, that this proposition is $\{<\mathbf{w,t}>: Max = Max\}$.

The semantics of $THIS_i^N$ and MAX_j is almost the same. The only difference is that names possibly refer in a more "objective" way, e.g. by a causal chain.
Let us now turn to the interpretation of common nouns.It has been noticed by some people that common nouns are context-dependent words, too. (Vide Cresswell (1973) and Enç (1981).)
CNs must sometimes be evaluated against a temporal background which is not necessarily identical with the time the verb speaks about, as the following examples show.

(14) The fugitives are in jail now. [11]

(15) The birth of the hundredth president of the U.S. will take place in Konstanz.

(16) Elisabet knows every linguist.

In (14), fugitives can t denote actual fugitives without making this sentence contradictory. The term obviously is about fugitives in a particular past determined by the context. Consider (15.). At the time when the event of the birth of the hundredth president takes place, he will not be a president yet. On the other hand, when he is president, he won't be born anymore. So president must denote presidents at some time after the birth of the hundredth one. (16) does not mean that Elisabet only knows the present linguists. She knows all linguists of the last ten years. Thus, linguists must be about those. There is no obvious way in which these readings can be expressed by means of the traditional analysis of tenses and common nouns. We can account for these facts if we let a **CN** express the property of being a so and so at some time in the temporal background provided by the context.
Cresswell has noticed that the content of **CN**s sometimes also depends on places (or individuals quite generally) to be specified by the context.

(17) Every mayor is buried in this cemetery.

[11] This example is taken from Enç (1981)

(18) Every child gets a candy.

In (17), <u>mayor</u> may denote the late mayors of Konstanz and, in (18), <u>child</u> may denote the children in one form. I will, however, ignore this feature of **CN**-meanings.

Enç even believes that **CN**s have to be evaluated against a particular modal background, which may change with the context. She gives examples like these (<u>vide</u> Enç (1981),p. 231f.).

(18) John believes that every unicorn descends from a white horse which my grandfather owned
80 years ago.

(20) In John's dream, every unicorn was chasing a secretary of mine.

There is a reading of (19) which involves more than one actual white horse of my grandfather's and there is a reading of (20) which involves more than one of my actual secretaries. It seems to be very difficult to get these readings by means of the traditional quantifying in method. I will, however, ignore. such cases as well.

This said, I am ready for the formulation of meaning rules for **CN**s. Let us call any set of times (i.e., time intervals) a **temporal background**.

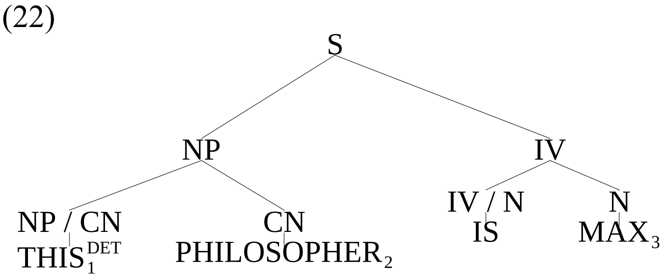
(21) PHILOSOPHER$_{\mathbf{i}}$ is a **CN**, for any number **i** . $|$PHILOSOPHER$_{\mathbf{i}}|$ is that **CN**-character ω such that for any **c**:

(i) ω(**c**) is defined only if $\mathbf{a_c}$ has, when uttering "PHILOSOPHER$_{\mathbf{i}}$" in $\mathbf{w_c}$ at $\mathbf{t_c}$, a temporal background $\mathbf{T}_i$ in the mind.

(ii) For any **c** in the domain of ω, any individual **u** in the domain of ω(**c**) and any world-time <w,t>:
<w,t> ∈ ω(**c**)(**u**) iff ($\exists$t*∈$\mathbf{T}_i$)(**u** is a philosopher in **w** at **t***).

Let us apply this for interpreting the following sentence.

(22)



We still need a meaning rule for the demonstrative article. It is this.

(23) THIS$_{\mathbf{i}}^{DET}$ is an (**NP**/**CN**) for any number **i**. $|$THIS$_{\mathbf{i}}^{DET}|$ is that function ξ ∈ $M_{(\mathbf{NP/CN})}$ such that for any $\omega_1 \in M_{\mathbf{CN}}$ and $\omega_2 \in M_{\mathbf{IV}}$ and any **c**:

(i) ξ(ω_1)(ω_2)(**c**) is defined only if $\mathbf{a_c}$ is referring by "THIS$_{\mathbf{i}}^{\mathbf{DET}}$" in $\mathbf{w_c}$ at $\mathbf{t_c}$ to exactly one individual **u** such that **<**$\mathbf{w_c}$,$\mathbf{t_c}$**>** ∈ ω_1(**c**)($\iota_{\mathbf{u}}$). ($\iota_{\mathbf{u}}$ is the constant **N**-character giving **u** for any context)

(ii) For any such **c**, $\xi(\omega_1)(\omega_2)(\mathbf{c}) = \{\langle \mathbf{w,t}\rangle : \langle \mathbf{w,t}\rangle \in \omega_2(\iota_{\mathbf{u}})\}$, where **u** is the character determined by condition (i)

Suppose now that (22) is uttered at a context **c** which satisfies the following conditions (contextual presuppositions).

(a) a is referring by "$THIS_1^{DET}$" to Max (This takes place $\mathbf{w_c}$ at $\mathbf{t_c}$, of course.).

(b) The temporal background which $\mathbf{a_c}$ has in mind when he says "$PHILOSOPHER_i$" contains only the time stretch starting at some time during 1940 and going up to $\mathbf{t_c}$. Let us denote this set by $\{\mathbf{t_2}\}$.

(c) MAX_3 refers to Max.

Under these conditions, $|(22)|\mathbf{c}$ will express the proposition $\{\langle w,t\rangle : Max = Max\}$.This is so, because Max has the property of being a philosopher for the whole time $\mathbf{t_2}$ (his mother told me that he started philosophizing in his early years, and he never stopped doing so up to $\mathbf{t_c}$) .
So $\langle THIS_1^{DET}, PHILOSOPHER_2\rangle$ is an appropriate "name" for Max in the context described above. Thus, with respect to this context, (22) expresses exactly the same proposition which (13), <u>i.e.</u>, "This is Max", did express when it was uttered. But, of course, the contextual presuppositions of the characters $|(13)|$ and $|(22)|$ are different. $|(22)|$ contextually presupposes that $|THIS_1^{DET}|$ uniquely refers to someone who is a philosopher at some time of the temporal background $\mathbf{T_1}$ whereas $|(13)|$ does not presuppose that. $|(13)|$ only requires that $THIS_1$ refers to exactly one object. Thus, the proposition $|(22)|\mathbf{c}$ does not entail that Max is a philosopher (at $\mathbf{t_2}$), though it presupposes that. If you don't like this, you have to change the meaning rule (23) in an obvious way: (23 ii) has to be replaced by the following stipulation:

(23) (ii') For any such **c**, $\xi(\omega_1)(\omega_2)(\mathbf{c}) = \{\langle \mathbf{w,t}\rangle : \langle \mathbf{w,t}\rangle \in \omega_1(\mathbf{c})(\mathbf{u})$ and $\langle \mathbf{w,t}\rangle \in \omega_2(\iota_{\mathbf{u}})\}$

As for myself, I like the rule (23) without this modification. I think "this philosopher" is just a context-dependent name and directly referential in the same way as "This". The open property 'philosopher' just adds some information to the 'demonstration' which is required in order to fix the referent of "This". (<u>Vide</u> Kaplan (1977).)
It follows from this that $THIS_i^{DET}$ could have been classified equally well as an (**N/CN**).
It is a consequence of this semantics that a sentence like

(24) This philosopher is no philosopher

never expresses a semantic contradiction. If <u>philosopher</u> means 'actual philosopher' for both occurrences of this symbol, (24) expresses no proposition. The utterance is pragmatically self-defeating. If the first occurrence of <u>philosopher</u> means 'former philosopher' and the second one means 'actual philosopher' , we get an informative statement. (It remains to investigate whether (24) can ever have such a reading.)
Let us have a look at our example (16) again, here repeated as (25).

(25) Elisabeth knows every linguist.

We interpret <u>every</u> in the usual way.

(26) EVERY is an (**NP/CN**).
|EVERY| is that function $\xi \in M_{(\mathbf{NP/CN})}$ such that for any $\omega_1 \in \mathbf{M_{CN}}$ and any $\omega_2 \in \mathbf{M_{IV}}$ and any **c**:

(i) $\xi(\omega_1)(\omega_2)(\mathbf{c})$ is defined only if $\omega_1(\mathbf{c})$ is defined and ω_2 is defined for any $\iota_{\mathbf{u}}$, where $\iota_{\mathbf{u}}$ is a constant
N-character such that $\omega_1(\mathbf{c})$ is defined for **u**.

(ii) For any such **c**, $\xi(\omega_1)(\omega_2)(\mathbf{c}) = \{\langle\mathbf{w,t}\rangle : (\forall x)(\langle\mathbf{w,t}\rangle \in \omega_1(\mathbf{c})(\mathbf{x})$ and $\langle\mathbf{w,t}\rangle \in \omega_2(\iota_{\mathbf{x}}))\}$

Thus, EVERY is one of the few words which are not treated as indexicals.
Suppose we formalize (25) as (27):

(27) <<EVERY, LINGUIST_2 > ,<λ,x, <ELISABET_1, KNOWS, **x**>>>, where **x** is a variable of category **N**.

Suppose further that the temporal background T_2 which is needed for the determination of the **CN** LINGUIST_2 contains the days of the last ten years, including the actual day. Given such circumstances, (27) will express the proposition that Elisabet knows everyone who is a linguist at one of the days contained in T_2 . It should be clear from this example that our **CN**-semantics also enables us to treat the problematic sentences (14) and (15).
It remains to be said what the meanings of "now" and "here" are. These words should be analyzed as adverbs. For the sake of transparency, I will, however, treat these words as names. "now" will denote the actual time and "here" the actual place of the agent. This amounts to the following two rules.

(28) NOW is an **N**. |NOW|**c** = $\mathbf{t_c}$

(29) HERE is an **N**. |HERE|**c** = the place where $\mathbf{a_c}$ is in $\mathbf{w_c}$ at $\mathbf{t_c}$.

These rules are gross oversimplifications. They exclude, for instance, a demonstrative use, a use we have to assume for the interpretation of the following sentence:

(30) Max is sitting here and Ede is sitting here.

The speaker is walking around when he says this. (Vide Klein (1978) und Stechow (1982) for cases like this). A similar point can be made for "now". I will assume that the "logical forms" of (30 i) and (31 i) are (30 ii) and (31 ii) respectively:

(30) i. It is now 3.49 a.m.
ii. <NOW, <IS, 3.49 A.M._i>>

(31) i. Here is Otaki Forks.
ii. <HERE, <IS, OTAKI FORKS_j>>

The meaning rule for 3.49 A.M_i is something like this.

(32) 3.49 A.M_i is an **N** for any number **i**.
|3.49 AM_i|**c** is defined only if

i. $\mathbf{a_c}$ has a temporal background in mind containing a particular day, when he says "3.49 A.M$_i$ "
For any such **c**:

ii. $|3.49\ AM_i|\mathbf{c}$ = 3.49 a.m. of the day contained in the background.

It follows from this treatment that (30 ii) and (31 ii) will assign a non-informative proposition to any context in their domain.
Let me stress again that it is not adequate to analyse NOW and HERE as names. Our treatment will already fail in view of such simple sentences as the following ones:

(33) Ede is sleeping now.

(34) Ede is sleeping here.

In order to account for these cases we have to change our verb-and tense semantics drastically. For the purposes of this article, however, the analysis is sufficient. For a more serious account of these words vide Stechow and Bäuerle (1980) and Stechow (1982). Let me conclude this section by specifying the meaning of the locative copula the existence of which I have assumed in section 1.

(35) AM_{loc} is an (**IV/N**). $|AM_{loc}|$ is that function ω in M such that for any ι_1 , $\iota_2 \in \mathbf{M_N}$ and any **c**:

i. $\omega(\iota_2)(\iota_1)(\mathbf{c})$ is defined only if $\iota_1(\mathbf{c})$ and $\iota_2(\mathbf{c})$ are defined and $\iota_2(\mathbf{c})$ is a place.

Whenever this is defined, we have for any <w,t>

ii. $\langle w,t\rangle \in \omega(\iota_2)(\iota_1)(\mathbf{c})$ iff $\iota_1(\mathbf{c})$ is located at $\iota_2(\mathbf{c})$ in **w** at $\mathbf{t_c}$

It follows from this and the previous rules that the following sentence is true at any context of utterance:

(36) <**I**, <AM_{loc} , HERE>>.

9. The formal analysis of diagonalization

The formal analysis of diagonalization is interesting for several reasons. First. Diagonalization is a "character - sensitive" operation and has certain logical properties which are quite different from the properties of any other operation we are acquainted with in linguistic semantics. It is hard to detect these by means of a purely informal discussion. Second. After a deeper understanding of diagonalization we suddenly see that it is possible to formalize the informative readings of some difficult cases which we discussed in section 4. Third. One of the aims of this paper is to compare a theory of relational attitude with some views which I attribute to Stalnaker. Since Stalnaker gives only a very informal account of his method, it is useful to have a clear understanding of diagonalization before doing so.

This is the formal analysis of diagonalization.

(1) Let Δ be a symbol in category (**IV/S**). Δ is called <u>diagonalization operator</u>. $|\Delta|$ is the following function φ in $M_{(IV/S)}$.

For any $\Pi \in \mathbf{M_S}$, any $\iota \in D_{\mathbf{N}}$ and any context **c**:

(i) $\varphi(\Pi)(\iota)(\mathbf{c})$ is defined only if ι is a constant individual character and $\Pi(\mathbf{c}^{\iota(\mathbf{c})}/\mathbf{a_c})$ is defined
(<u>i.e</u>. Π is defined for $\langle \iota(\mathbf{c}), \mathbf{w_c}, \mathbf{t_c} \rangle$).

For any Π, ι and **c** meeting this condition:

(ii) For any $\langle w,t \rangle$:
$\langle \mathbf{w,t} \rangle \in \varphi(\Pi)(\iota)(\mathbf{c})$ iff $\langle \mathbf{w,t} \rangle \in \Pi(\mathbf{c'})$ where $\mathbf{c' = c}^{\iota(\mathbf{c})}/\mathbf{a_c}\ ^{\mathbf{w}}/\mathbf{w_c}\ ^{\mathbf{t}}/\mathbf{t_c}$
(<u>i.e</u>. $\mathbf{c'} = \langle \iota(\mathbf{c}), \mathbf{w}, \mathbf{t} \rangle$).

This semantics allows for a correct analysis of the sentences considered in section 3. Let us give a short review.

(2) I believe that I am David.

We are interested in the following reading:

(3) I self-ascribe $\lambda\mathbf{p}[\mathbf{p}$ = David].

We get a reading which is fairly similar to this if we formalize (2) as (4):

(4) $\langle$I,$\langle$BELIEVE$_{\text{de me}}$,$\langle\Delta$,$\langle$I,$\langle$AM, DAVID$_1\rangle\rangle\rangle\rangle\rangle$

We have to assume, of course, that BELIEVE$_{\text{de me}}$ is an (**IV/IV**) which denotes the relation 'self-ascription' , <u>i.e</u>. we have to assume the following meaning rule.

(5) $|$BELIEVE$_{\text{de me}}|$ is that function ψ, in $M_{(\mathbf{IV/IV})}$ such that for any $\iota \in M_{\mathbf{N}}$, $\omega \in M_{\mathbf{IV}}$ and any context **c**:

(i) $\varphi(\omega)(\iota)(\mathbf{c})$ is defined iff $\omega(\iota)(\mathbf{c})$ is defined.

For any ω, ι, and **c** meeting this condition and any $\langle \mathbf{w,t} \rangle$:

(ii) $\langle \mathbf{w,t} \rangle \in \varphi(\omega)(\iota)(\mathbf{c})$ <u>iff</u> $(\forall \mathbf{u}, \mathbf{w'}, \mathbf{t'})$ [<u>If</u> $\langle \mathbf{u}, \mathbf{w'}, \mathbf{t'} \rangle$ is a doxastic alternative of $\langle \iota(\mathbf{c}) ,\mathbf{w}, \mathbf{t_c} \rangle$,
<u>then</u> $\langle w', t' \rangle \in \omega(\iota_{\mathbf{u}})(\mathbf{c})$], where $\iota_{\mathbf{u}}$ is the constant **N**-character giving **u** for any **c**.

Let us evaluate sentence (4) in order to see that these meaning rules give us good results. Suppose $|(4)|(\mathbf{c})$ is defined. Then $|(4)|(\mathbf{c})$ is the proposition **p** which is true in a world **w** at a time t if the following statement is true.

(a) $(\forall \mathbf{u}, \mathbf{w'}, \mathbf{t'})$[<u>If</u> $\langle \mathbf{u}, \mathbf{w'}, \mathbf{t'} \rangle$ is a doxastic alternative of $\langle \mathbf{a_c}, \mathbf{w}, \mathbf{t_c} \rangle$,
<u>then</u> $\langle \mathbf{w'}, \mathbf{t'} \rangle \in |\langle\Delta$,$\langle$I,$\langle$AM, DAVID$_1\rangle\rangle\rangle|(\iota_{\mathbf{u}})(\mathbf{c})$]

Consider the consequent of the embedded conditional. By definition of the meaning of the Δ-operator, it is true iff the following is the case:

(b) <**w', t'**> ∈ |<I,<AM, DAVID$_1$>>|(**c'**)]
where **c'** = <**u, w', t'**>.

This is the case if

(c) **u** = the individual denoted by "DAVID$_1$ in **w'** at **t'**.

In order to get (c) from (d), I relied on the meaning rules for I, AM and DAVID$_i$. Vide the preceding section.
If we put this together we obtain as a result that |(4)|(**c**) is the proposition which is true in a world **w** at a time **t** iff (d) holds:

(d) (∀**u**, **w'**, **t'**)[If <**u**, **w'**, **t'**> is a doxastic alternative of <**a$_c$**, **w, t$_c$**> , then **u** = the person which
is referred to by "David$_1$" in **w'** at **t'**.

So (4) roughly means that I self-ascribe the property of being the person called "David".
The formalization of diagonalization makes an interesting property of this notion visible, which we would hardly have detected, if we had discussed the matter on an intuitive level only. The property is this: *Under diagonalization, directly referential terms ("rigid designators") become descriptive terms ("non-rigid designators").*
If we look back at our example, we have an illustration of this claim. Clearly, the person which is referred to by "DAVID$_1$" in **w'** at **t'** is, in general, a different one for different worldtimes <**w'** ,**t'**>, though DAVID$_1$ is a "rigid designator". In other words, (6) does not mean the same as (7). (6) rather means something like (8).

(6) <Δ,<I,<AM, DAVID$_1$>>>

(7) <λ, **x**,<**x**,<AM, DAVID$_1$>>>|, where **x** is an **N**.

(8) λ**p**[**p** is the person called "David"]

If we want to have the property expressed by (7) as an object of attitudes and also want to use the method of diagonalization then we have to use the "quantifying in" method. For instance, the following two sentences are equivalent:

(8) i. <I, <BELIEVE$_{de\ me}$ <λ, **x**, <**x**, <AM, DAVID$_1$>>>>>
ii. <DAVID$_1$,<λ,x, <I, <BELIEVE$_{de\ me}$, <Δ, <I, AM, **x**>>>>>>, **x** is in category **N** for both sentences.

On the other hand, (4), here repeated as (8 iii), is not equivalent to either (8 i) or (8 ii), but (4) is, of course, equivalent to (8 iv).

(8) iii. <I, <BELIEVE$_{de\ me}$ <Δ, <I, <AM, DAVID$_1$>>>>>
iv. <I, <BELIEVE$_{de\ me}$, <Δ, <DAVID$_1$,<λ,x, <I, <AM, **x** >>>>>>> where **x** is of category **N**.

These examples illustrate an interesting property of the Δ-operator, which has something to do with the fact that it affects the "rigidity" of names " λ-conversion" is only possible for cases where the variable bound by the λ-operator is not in the scope of a Δ-operator (or some other "character-sensitive" operator). More precisely, let α be an **S** containing no Δ-operator (or other operator of this kind), let **x** be a variable of category **N** and let β be a constant of category **N**. Then <α, <λ, x, α>> is equivalent to α[β/x][12]. If, however, **x** is a variable which is free in α and which is in the scope of a Δ-operator, then this equivalence is not valid anymore. Let us express this somewhat more explicitly.

Suppose **A**(β_1, ..., β_n) is an **S** which contains the **N**s β_1, ..., β_n (none of these being a variable). Let us further assume that **A**(β_1, ..., β_n) contains no Δ-operator. Then a sentence of form

(9) ...<Δ, <**A**(β_1, ..., β_n) >> is in general <u>not</u> equivalent to

(10) <<β_1, ..., β_n, <λ, $\mathbf{x}_1$, ..., $\mathbf{x}_n$, <...<Δ, <**A**(β_1, ..., β_n) [$^x{}_1/\beta_1, ..., {}^x{}_n/\beta_n$]>>...>>>,

where $\mathbf{x}_1$, ..., $\mathbf{x}_n$ are "new" variables, <u>i.e</u>. variables not occurring in (9). Notice that (9) and (10) are equivalent under very special conditions, <u>viz</u>. where β_1, ..., β_n all express constant characters, a case that never occurs in natural language, as far as I can see.

Let us make our talk about 'rigidity' more precise now. The term "rigid designator" has been coined by Kripke. Mostly, it is made precise in the following way: The contents of names are <u>individual concepts</u>, <u>i.e</u>. functions from **W**×**T** into the set of individuals. Name characters are functions from the set of contexts into the set of individual concepts. Rigidity means that, with respect to any particular context of use, the content of a name is a constant individual concept. Hence the content of a rigid designator is a function that picks out the same individual for every world and time. If our **N**-contents were individual concepts, we could say this:

(11) An **N**-character ι is rigid <u>iff</u> (∀**c**)(∃**x** ∈ **A**)(∀**w,t**)(ι(**c**)(**w,t**) = **x**).

But our **N**-contents are not individual concepts but simply members of $D_{\mathbf{N}}$. We therefore can't define rigidity in this way. But we can express what rigidity means, if we "lift" names to the **NP**-level.The **NP** that corresponds to the **N** DAVID_i is the following one.

(12) DAVID_i^* is an **NP** for any number i. $|\mathrm{DAVID}_i^*|$ is that function ζ ∈ $\mathbf{M}_{\mathbf{NP}}$ such that for any ω ∈ $\mathbf{M}_{\mathbf{IV}}$
and any context **c**:

(i) ζ (ω)(**c**) is defined <u>iff</u>
  (a) "DAVID_i" refers to exactly one individual in $\mathbf{w}_\mathbf{c}$ at $\mathbf{t}_\mathbf{c}$ and
  (b) ω(ι)(**c**) is defined, where $\iota_\mathbf{u}$ is the constant **N**-character which gives us **u** for any **c** and **u** is the individual determined by condition (a).

For any ω and **c** meeting this condition and any <**w,t**>

(ii) <**w,t**> ∈ ζ (ω)(**c**) iff <**w,t**> ∈ ω($\iota_\mathbf{u}$) where $\iota_\mathbf{u}$ is the **N**-character determined by condition (i).

[12] For details concerning λ-conversion and the substitution operator [β/x], vide Cresswell (1973)

We can convince ourselves that for any $\omega \in \mathbf{M_{IV}}$, $|\text{DAVID}_i{}^*|(\omega) = \omega(|\text{DAVID}_i|)$. So, in a sense, $\text{DAVID}_i{}^*$ and DAVID mean exactly the same. There is only a difference in logical type[13]. We are now in a position to say what rigidity is.

(13) (i). Let ζ be any **NP**-meaning, <u>i.e</u>. any function in $M_{(S/(S/N))}$. ζ is a <u>rigid designation</u> iff for any $\omega \in M_{(S/N)}$ and context **c** such that $\zeta(\omega)(\mathbf{c})$ is defined: $(\exists \mathbf{u} \in D_N)(\forall \mathbf{w,t})[<\mathbf{w,t}> \in \zeta(\omega)(\mathbf{c}) \text{ iff } <\mathbf{w,t}> \in \omega(\iota_\mathbf{u})(\mathbf{c})]$, where $\iota_\mathbf{u}$ is the constant **N**-character giving **u** for any **c**.

(ii) An expression α of category **NP** is a <u>rigid designator</u> iff $|\alpha|$ is a rigid designation[14].

I have said that, for any expression of type **N**, α and α^* mean the same. To say that an N,α^*, is rigid therefore means that α^* is a rigid designator. It is a direct consequence of our semantics for **N**s that any **N** is a rigid designator.

I am now in a position to say what it means for rigid designator to b e c o m e (n o n - r i g i d) descriptions under diagonalization. Let

(14) $...<\Delta, <\mathbf{A}(<\Delta, <\mathbf{A}(\beta_1, ..., \beta_n) >>) >>...$ be an **S** of the form described in (9) with the further proviso that none of the $\beta_1, ..., \beta_n$ is an ego-centric indexical. <u>i.e.</u> no $\beta_i \in \{$**I**, NOW, HERE, THOU, ...$\}$. Then there are descriptive NPs $\gamma_1, ..., \gamma_n$ such that the following statement is true (provided our language is rich enough, of course):

(15) (14) is equivalent to
$<...<\Delta,<\gamma_1,<\lambda,x_1,<...<\gamma n,<\lambda,x_n,<\mathbf{A}(\beta_1,...,\beta_n)[^{\mathbf{x1}}/\beta_1,...,^{\mathbf{xn}}/\beta_n]>>>...>>>>...>$
though $|\gamma_i| \neq |\beta^*_i|$, for i = 1,..., n.

Let me illustrate this claim by means of the examples discussed above. We already know that (8 iii) and (8 ii), here repeated as (16 i) and (16 ~~); respectively, are not equivalent:

(16) i. $<\mathbf{I}, <\text{BELIEVE}_{\text{de me}} ,<\Delta,<\mathbf{I},<\text{AM, DAVID}_1>>>>>$
ii. $<\text{DAVID}_1,<\lambda,\mathbf{x},<\mathbf{I},<\text{BELIEVE}_{\text{de me}}<\Delta,<\mathbf{I},<\text{AM},\mathbf{x}>>>>>>>$

We also know that (16 iii) is equivalent to (16 i), and therefore not to (16 ii):

(16) iii. $<\mathbf{I}, <\text{BELIEVE}_{\text{de me}}< \Delta, <\text{DAVID}_1,<\lambda,\mathbf{x},<\mathbf{I},<\text{AM},\mathbf{x}>>>>>>$

[13] The starnotation is reminescent of Montague's notation found in PTQ, p.266ff.. Remember that David* is short for ^λP[P{^david}] where david is an **e**, i.e., a name. It's exactly the same procedure.

[14] We could also define the notion of hyperrigid designator. That would be an NP giving us the same individual for every context. If we extend the star notation to variables, then **x*** is a hyperrigid designator for any **N**-variable x. I have found a terminology of this kind in an unpublished paper by van Fraassen.

We will showthat there is a descriptive NP γ such that $|\gamma| \neq |\text{DAVID}_1{*}|$ but (16 iv) is equivalent to (16 iii) and therefore also to (16 i).

(16) iv. $<\mathbf{I}, <\text{BELIEVE}_{\text{de me}},<\Delta ,<\gamma,<\lambda,\mathbf{x},<\mathbf{I},<\text{AM},\mathbf{x}>>>>>>>$

This will illustrate claim (15). Let γ be the **NP** THE PERSON CALLED DAVID_1 defined by the following meaning rule.

(17) THE PERSON CALLED DAVID_i is an **NP** for any number i.

$|\text{THE PERSON CALLED DAVID}_i|$ is that function φ in $\mathbf{M_{NP}}$ such that for any $\varphi \in \mathbf{M_{NP}}$ any context c and any $<\mathbf{w},\mathbf{t}>$:

$<\mathbf{w,t}> \in \varphi(\omega)(\mathbf{c})$ iff $(\exists \mathbf{x})[(\forall \mathbf{y})(\mathbf{y}$ is referred to by "DAVID_i" in **w** at **t** $\Leftrightarrow \mathbf{x} = \mathbf{y}) \;\&$
$<\mathbf{w,t}> \in \omega(\iota_x)(\mathbf{c})]$, where ι_x is the constant **N**-character which gives **x** for any **c**.

This **NP** is a Russellian description and hence a descriptive **NP**. I have said that (16 iv) is equivalent to (16 iii). If we spell out the truth conditions of these sentences, then we see that this is not entirely accurate.
$|16\text{ iv}|$(c), if defined, is true in a world **w** at a time **t** iff

(18) $(\forall \mathbf{b},\mathbf{w}',\mathbf{t}')(<\mathbf{a_c},\mathbf{w},\mathbf{t}> \mathbf{L} <\mathbf{b}, \mathbf{w}',\mathbf{t}'>$
$\Rightarrow (\exists \mathbf{x})[(\forall \mathbf{y})(\mathbf{y}$ is referred to by "DAVID_1" in **w'** at **t'** $\Leftrightarrow \mathbf{x} = \mathbf{y}) \;\&\; \mathbf{x} = \iota_b(\mathbf{c})]$

L is Lewis-accessibility, as defined in (5.12).On the other hand, (16 iii) (**c**) is true in a world **w** at time **t** iff

(19) $(\forall \mathbf{b},\mathbf{w}',\mathbf{t}')(<\mathbf{a_c},\mathbf{w},\mathbf{t}> \mathbf{L} <\mathbf{b}, \mathbf{w}',\mathbf{t}'> \Rightarrow \mathbf{b}$ is the object referred to by "DAVID_1"in in **w'** at **t'**).

The point is that there might be no object referred to by "DAVID_1" in **w'** at **t'** . In such a case, the consequent of the embedded conditional of (18) would be false, whereas it is not clear whether it is true or false in the case of (19). There are several ways of repairing this. One could either work with partial propositions in order to make (16 iii) and (16 iv) synonymous. One would have to redefine (17) in such a way that the description would be undefined in case the name did not refer uniquely. (Cf. Stechow (1981b)).
Another possibility would be to make the consequent of the conditional false by some appropriate stipulation, if the name does not refer. (Vide Klein (1978)). For the present discussion, let us simply assume that "DAVID_1" refers to exactly one object for any $<\mathbf{w,t}>$

I think this explanation makes sufficiently clear what I meant when I said that rigid designators become non-rigid descriptions under the Δ-operator.

It is tempting to make use of this property of the Δ-operator in order to solve the Frege-problem for names (and also for demonstratives) by means of the diagonalization method. This has been tried by Robert Stalnaker on several occasions (Cf. Stalnaker (1978) and Stalnaker (1979))
Consider the paradigm case.

(20) O'Leary doesn'tbelieve that Hesperus is Phosphorus.

Suppose we represent this as (21).

(21) <O'LEARY$_1$, <BELIEVES$_{de\ se}$
<Δ, <NOT, <HESPERUS$_2$ <IS, PHOSPHORUS$_3$>>>>>

Clearly, this formalization makes the object of belief informative. It is, roughly speaking, the property of living at a world-time where the object called "HESPERUS$_2$" is not identical with the object called "PHOSPHORUS$_3$". (You could have chosen a formalization giving wide scope to NOT as well. That would have made the property (in fact, a proposition) informative, too. It would then be a differe property, of course.)

The method works for the Frege-problem of demonstratives as well (Cf. Kaplan (1977) p.37)

(22) <u>That</u> [pointing to Venus in the morning sky] <u>is identical with that</u> [pointing to Venus in the evening sky]

Kaplan comments on this: "I would, of course, have to speak very slowly". I am taking the view, of course, that the objects of assertions are properties. An informative property asserted by (22) would be the following:

(23) <Δ, <THAT$^{\mathbf{N}}_{\mathbf{1}}$, <IS,THAT$^{\mathbf{N}}_{\mathbf{2}}$>>>

Assume for THAT$^{\mathbf{N}}_1$ the same semantics as for THIS$^{\mathbf{N}}_i$ (cf. 8.10)).
(23) expresses the property of referring by "THAT$^{\mathbf{N}}_1$" to the same object as by "THAT$^{\mathbf{N}}_1$". Notice, incidentally, a subtle difference between this property and

(24) <Δ, <HESPERUS$_1$, <IS, PHOSPHORUS$_2$>>>.

(24) is a proposition, whereas (23) is not, because "THAT$^{\mathbf{N}}_i$"is an egocentric indexical whereas HESPERUS$_i$ and PHOSPHORUS$_i$ are not.

Although diagonalization makes the object of the attitude informative in each of these cases, I am not sure whether this kind of solution is correct. I think it is revealing that Kaplan uses two acquaintance relations for the description of the intended meaning of (22), the relation 'pointing to **x** in the morning sky' and the relation 'pointing to **x** in the evening sky'. This suggests that a relational analysis is more adequate. The formalization (23) does not contain any information that the subject of the attitude is <u>realiter</u> related to Venus by these relations. The same point can be made for (21). So I have my doubts whether diagonalization will explain the Frege-problem entirely.

Let me now come back to examples which were difficult to explain when we were discussing diagonalization on the informal level (cf. section 4).

(25) Max believes that I am Ruth

The following formalization makes the object of belief informative.

(26) <I, <λ,**x**, <MAX$_1$, <BELIEVES$_{de\ se}$ <Δ, <**x**, <AM, RUTH$_2$ >>>>>>>

The self-ascribed property is the property of living in circumstances where Arnim is the person called "Ruth". In a similar way we can treat the sentences (27) to (29):

(27) i. Ruth believes that here is Totara Flats.

ii. <HERE,<λ, **x**, <RUTH$_1$, <BELIEVES$_{de\ se}$,<Δ ,< **x**, <IS, TOTARA FLATS$_2$>>>>>>>.

The proposition believed is the set of world-times where Totara Flats is called "Totara Flats", certainly a contingency.

(28) i. Lingens believes that he is David Lewis.
ii. <HE$_1$,<λ, **x**, <LINGENS$_2$, <BELIEVES$_{de\ se}$,<Δ ,< **x**, <IS, DAVID LEWIS$_1$>>>>>>>.

Assume for HE. the same semantics as for proper names. The object iof belief is the proposition that Lingens is the one who is called "David Lewis".

(29) i. Thou believest that thou art David Hume.
ii. <THOU,<λ,**x**, <THOU, <BELIEVEST$_{de\ te}$,<Δ,< **x**, <ART, DAVID HUME$_1$>>>>>>>.

The belief is the proposition that you are the one who is called "David Hume".

In all these cases the object of belief is an informative proposition. The examples seem, however, to point to a certain weakness in the expressive power of the theory of diagonalization. In the last examples, the object of belief was a proposition, and it <u>had</u> to be one. We can't always have the property of being David Lewis as the object of belief. This can be seen if we compare the following two sentences:

(30) I believe that I am D. Lewis.

(31) Thou believest that thou art D. Lewis.

If we formalize (30) as (32), then the object of belief is the property of being D. Lewis.

(32) <D. LEWIS$_1$,<λ,**x**, <I, <BELIEVE$_{de\ me}$,<Δ, <I, <AM,**x** >>>>>>>

If we try to formalize (31), we first remember that the <u>thou</u> of the embedded sentence has to be λ-exported (cf. (29)). Otherwise we would certainly get a wrong reading. So we start our formalization by considering (29 ii). Now we λ-export DAVID LEWIS$_1$ and get (33):

(33) <DAVID LEWIS$_1$,<λ,**y**, <THOU,<λ,**x**, <THOU, <BELIEVEST$_{de\ te}$ <Δ,< **x**, <ART, **y** >>>>>>>>,

But now the object of belief is a tautology or contradiction. So this can't be right. On the other hand, (29 ii) was not right either. The object of belief in (29 ii) was not the property of being D. Lewis but rather the proposition that you are the one which is called "David Lewis". We don't get the required property for the following reason. In order to get a property of persons under the Δ-operator, we must have at least one egocentric word in its scope. The Δ-operator may be regarded as a sort of λ-abstraction: it abstracts over contexts. It gives us a property if an egocentric word occurs within its scope, a proposition otherwise. In (33), only the variables **x** and **y** are in the scope of Δ. Variables are "hyperrigid" (cf. the footnote on p. 000) and can never be "bound" by the Δ-operator. Hence the uninformativeness of the embedded S. I find this an interesting consequence in view of the fact that (30) and (31) are parallel in virtually every respect. A theory of relational attitude can give the same content to both (30) and (31). So it is certainly more expressive.

Diagonalization is able to account for the Lakoff-puzzle:

(34) i. I dreamt I was Brigitte Bardot and I kissed me.
ii. <I,<λ,**x**, <I, <DREAMT$_{de\ me}$ <Δ,<<I, <AM, BB$_1$>>, AND, <I, <KISS, **x**>>>>>>>>>.

This is the proposition that Arnim dreamt he had the property of being the person called "Brigitte Bardot" and kissing Arnim. This is certainly a reasonable dream, though I never had it. It is interesting to compare this formalization with the representation of properties by means of λ-abstraction: the distribution of variables and relevant rigid designators is exactly complementary:

(35) i. <Δ,<<I, <AM,BB$_1$>, AND, <I, KISS,**x**>>>
ii. <λ,**x**, <<**x**,<AM,BB$_1$>, AND,<**x**,KISS,I>>>

This is a consequence of the fact that λ and Δ are "complementary" abstractions: one operates on variables, the other on contexts.

Let me sum up; this discussion by the following remarks. It seems to me that diagonalization is a method that can always make the object of attitude informative. So it can solve the problem of "informativeness". The question is only whether the method is intuitively correct in each case. Among other possible inadequacies, the de re-aspect of attitudes is certainly not accounted for in a general way. The discussion of the Frege-problem suggested that an attitude sometimes involves other relations of acquaintance between the subject and the objects of the attitude than just the pure egocentric relations like 'the person I am', or, 'the place where I am' and so on. The same point can be made for a lot of other examples. Diagonalization yields only what I have called pure de se-belief.

Let me mention another conceptual difficulty. When I gave an intuitive account of diagonalization, I had to use a counter-factual conditional (cf. section 2). When I gave the semantics for the Δ -operator, no counterfactual talk occurred. But the counterfactuality is reflected in the fact that the semantics has to make use of unrealizable (impossible) contexts. For instance, one has to consider the triple <Julius Caesar, the actual world, the actual time>. If we evaluate an indexical, say THIS^{N}_{i} , withrespect to such a context, then its denotation is the object referred to by Julius Caesar in the actual world at the present time by "THIS^{N}_{1}". This can only be a facon de parler, because Julius Caesar is not alive any more at the actual time and consequently can't say "THIS^{N}_{i}" under these circumstances. So intuitively, this facon de parler has to be interpreted counterfactually as "If Julius Caesar were present now and referred to exactly one object by "THIS^{N}_{i}"... To say the least, it is conceivable that some people don't find this awfully clear. As far as I can see, a relational analysis of attitude doesn't involve a conceptual difficulty of this kind.

10. THE FORMAL ANALYSIS OF RELATIONAL ATTITUDE

In section 5, I have given reasons for the view that the object of a relational attitude is a structured proposition, i.e. a pair <**P**$_1$, <**a**$_1$,...,**a**$_n$>>, where **P** is an n-place property and **a**$_1$,...,**a**$_n$ are appropriate arguments. For instance, there is a relational analysis of the sentence

(1) I believe that you are sick

which roughly means

(2) I attribute the property of being sick to you under **D**,

where **D** is a suitable description. The ontology developed so far does not allow to express this in a straightforward way. The reason is a purely technical one. The embedded that-clause of (1) roughly has the following structure:

(3) <YOU, ARE SICK>,

where YOU is an **N** and ARE SICK is an **IV**. Now, the value of ARE SICK is a function in $\mathbf{M}_{(S/N)}$ i.e. a function from **N**-characters into **S**-characters. This is not exactly the object I attribute to you in (2). The object attributed is the property of being sick now, a function in D We have (S/N) to get this property somehow from the function ARE SICK For that purpose, let me introduce the following definition.

(4) Suppose ω is a function in $\mathbf{M}_{(S/N^n)}$ ($\mathbf{N}^n$ is short for $N_1,..., N_n$. Let ω^+ be the following **CN**-character.

For any context **c** and and any $\mathbf{a}_1,...,\mathbf{a}_n \in \mathbf{D_N}$

(i) $\omega^+(\mathbf{c})(\mathbf{a}_1,...,\mathbf{a}_n)$ is defined iff $\omega(\iota_{(a)1}, ..., \iota_{(a)n})(\mathbf{c})$ is defined, where $\iota_{(a)\,i}$ is the constant **N** character giving $\mathbf{a}_i$ for any **c**.

For any **c** and $\mathbf{a}_1,...,\mathbf{a}_n$ meeting this condition and any <**w,t**>:

(ii) $<\mathbf{w,t}> \in \omega^+(\mathbf{c})(\mathbf{a}_1,...,\mathbf{a}_n)$ iff $<\mathbf{w,t}> \in \omega(\iota_{(a)1}, ..., \iota_{(a)n})(\mathbf{c})$

We assume that ω^+ is in $\mathbf{M_{CN}}$, provided is in $\mathbf{M}_{(S/N^n)}$

According to this definition, $|$ARE SICK$|^+(\mathbf{c})$ is the property of being sick at $\mathbf{t_c}$ i.e. a function in $\mathbf{D_{(S/N)}}$.

We have to somehow encode the information what the structure of an object of attitudesis. The symbol THAT serves this purpose. I follow the proposal made in Stechow and Cresswell (1981) and assume that there is an infinite family of THATs, each encoding a different structure of the that-clause. (It will turn out, however, that the present account is less general than our original proposal. This is so for purely technical reasons. I will comment on this peculiarityat the end of the paper.)

(5) THAT$_\tau$ is in category τ for any category τ of form (**N**/(**S**/**N**^{n}), N^n) $|$THAT$_\tau|$ is that function$\varphi \in$ **M** M such that for any $\omega \in \mathbf{M}_{(S/N^n)}$ any $\iota_1, ..., \iota_n \in \mathbf{M_N}$ and any context **c**:

(i) $\varphi(\omega)(\iota_1, ..., \iota_n)(\mathbf{c})$ is defined iff $\omega(\iota_1, ..., \iota_n)(\mathbf{c})$is defined.

For any ω, $\iota_1, ..., \iota_n$, and any context **c**:

(ii) $\varphi(\omega)(\iota_1, ..., \iota_n)(\mathbf{c}) = \iota^*(\mathbf{c})$, where ι^* is the individual character which gives us $<\omega^+(\mathbf{c}), \iota_1(\mathbf{c}), ..., \iota_n(\mathbf{c})>$.

We assume that $\mathbf{D}_N$ is large enough to contain $<\mathbf{P}_1,\mathbf{a}_1,...,\mathbf{a}_n>$ for any **n**-place property **P** and appropriate arguments $\mathbf{a}_1,...,\mathbf{a}_n$.

Let us consider an example. Let τ be the category (**N/(S/N),N**). Then the following expression is an **N**.

(6) <THAT$_\tau$, YOU, ARE SICK>. T

At an appropriate context **c**, |(6)|**c** is the pair

(7) <|ARE SICK|$^+$**c**, |YOU|c >,

i.e. the pair

(8) <being sick at $\mathbf{t_c}$ you$_c$>,

where you$_c$ is (are) the person(s) adressed by $\mathbf{a_c}$ in $\mathbf{w_c}$ at $\mathbf{t_c}$

We are now in a position to give the semantics for relational belief.

(9) BELIEVE is a symbol of category (**S/IV**). |BELIEVE| is that function ω in $\mathbf{M}_{(S/IV)}$ such that for any $\iota_1, \iota_2 \in \mathbf{M_N}$ and any **c**:

(i) $\omega(\iota_2)(\iota_1)(\mathbf{c})$ is defined only if the following conditions are satisfied:

(a) $\iota_1(\mathbf{c})$is an intelligent individual and

(b) $\iota_2(\mathbf{c})$is a structured proposition,

i.e. a sequence $<\mathbf{P}_1,\mathbf{a}_1,...,\mathbf{a}_n>$ where **P** is an **n**-place property and $\mathbf{a}_1,...,\mathbf{a}_n$ are appropriate arguments of **P**.

For any such ι_1, ι_2, **c** and any <**w,t**>:

(ii) $<\mathbf{w,t}> \in \omega(\iota_2)(\iota_1)(\mathbf{c})$ iff there are suitable descriptions $\mathbf{D}_1, ..., \mathbf{D}_n$ such that ι_1(c)ascribes **P** to $\mathbf{a}_1,...,\mathbf{a}_n$ under $\mathbf{D}_1, ..., \mathbf{D}_n$ in **w** at $\mathbf{t}_c$

Let us check this for our example (1). Its logical form is (10).

(10) <I,<BELIEVE,<THAT$_\tau$, YOU, ARE SICK>>>, τ = (**N/IV,N**).

Consider a context **c**, where |(10)|c is defined. We have seen that |<THAT, YOU, ARE SICK>|c is the structured proposition < being sick at $\mathbf{t_c}$ you$_c$ >.

According to (8ii), |(10)|c is true in a world **w** at time **t** iff there is same suitable relation **D** which $\mathbf{a_c}$ uniquely bears to you$_c$ at **w** in **t**. Furthermore, (in **w** at $\mathbf{t_c}$ $\mathbf{a_c}$ self-ascribes the property of bearing **D** uniquely to someone who is sick at $\mathbf{t_c}$. It might be useful to repeat this by means of a bit of symbolic notation: So, again: |(10)|c , if defined, is that proposition **p** such that for any $<\mathbf{w,t}>:<\mathbf{w,t}> \in \mathbf{p}$ iff there is a suitable relation **D** such that

(a) $(\exists \mathbf{x})(\forall \mathbf{y})(<\mathbf{w,t}> \in \mathbf{D}(\mathbf{a_c},\mathbf{y}) \Leftrightarrow \mathbf{x} = \mathbf{y})$ and

(b) (∀**b**,**w'**, **t'**)(<**a**$_{c}$,**w**,**t**> **L** <**b**,**w'** ,**t'**> ⇒ (∃**x**)[(∀**y**)(<**w'**,**t'**> ∈ D(**b**,**y**) ⇒ **x** = **y**) & **x** is sick in
w' at **t**$_{c}$]) where L is (doxastic) Lewis-alternativeness.

Notice that BELIEVE is an intensional operator (not a "hyperintensional " one like Δ) Therefore, λ-conversion is always possible for **N**s. Consider, for instance,sentence (29i) of the last section, here repeated as (11).

(11) Thou believest that thou art David Lewis.

We were not able to get the property of being David Lewis as an object of belief by means of the diagonalization method. A relational analysis can obtain this reading. The three sentences in (12) are equivalent. In each case the property attributed is the property of being David Lewis. If the attribution takes place <u>sub me</u>, then the sentences express the reading that you self-ascribe the property of being David Lewis.

(12) i. <THOU,<BELIEVEST,<THAT$_{\tau}$, THOU,<ART, D.LEWIS$_{1}$>>>>
ii. <THOU,<BELIEVEST,<THAT$_{\tau}$,<λ,**x**,<**x**, <ART, D.LEWIS$_{1}$>>> THOU>>>
iii. <D.LEWIS$_{1}$,<λ,**y**,<THOU,<BELIEVEST,<THAT$_{\tau}$<λ,**x**,<**x**,<ART,**y**,>>, THOU>>>>>>

In each case τ = (**N/IV,N**).

Our semantics does not express under which description a belief is held. I could of course have introduced an infinite set of belief-symbols, each of the form BELIEVED$_{(\mathbf{D})1, ..., (\mathbf{D})n}$ where **D**$_{1}$,...,**D**$_{n}$ stand for suitable descriptions. The account given above seems to be more realistic insofar as we don't express these descriptions when we talk.

Let me say a word about the Frege problem. Mostly, people argue that (13i) would be a reasonable belief whereas (l3ii) would not.

(13) i. Hesperus is different from Phosphorus.
ii. Hesperus is different from Hesperus.

I want to dispute the second claim. A believer of (13i) would certainly never express his belief as (l3ii), but we, the reporters of his error, can. (And Lord Russell certainly would have preferred (l3ii) to (13i), because it is less boring.) This is seen from the following example.

(14) i. O'Leary believes that Hesperus is not Hesperus.
ii. <O'LEARY$_{1}$, <BELIEVES,<THAT$_{\tau}$, HESPERUS$_{2}$, <λ,**x**,**y**,<NOT,<**x**,<IS,**y**>>>>, HESPERUS$_{3}$>>> , where τ = (N/(S/N^{2}),N^{2})

(l3ii) means that O'Leary ascribes difference to the pair <Venus,Venus> under some suitable relations **D**$_{1}$, **D**$_{2}$. Think of **D**$_{1}$ as 'pointing to **x** in the morning sky' and of **D**$_{2}$ as 'pointing to **x** in the evenin sky'. Clearly, the object of belief is informative in this case. And no extra method of reinterpretation is needed. The names are rigid designators and invariably have the same denotation, whether they occur inside or outside the scope of a beliefoperator. Thus, as far as I can see, a relational account of attitudes has no difficulties with the Frege-problem. These reasons and those given in the preceding section make me believe that a relational analysis of attitudes is superior to an analysis by means of diagonal ization.

11.THE FOCUS-SENSITIVITY OF INTERROGATIVES AND INTERROGATIVE-EMBEDDING OPERATORS

One and the same interrogative can express quite different contents as a result of different "focus- structures" Consequently, the "focus-structure" of an embedded interrogative will be relevant for the truth-conditions of the whole sentence, contrary to what I said in [1981a] but in agreement with Dretske [1972]and[1977]. That's the point I want to make in this section.

The view that the contents of interrogatives are structured is rather new. It was first argued for by Ruth Manor (cf. Manor (1981a)and Manor (1982)),but, to my knowledge, by nobody else. As will be seen further below, it has farreaching consequences for the theory of interrogatives.

In section 4 I have said that **wh**-movement means λ-abstraction and that, in the case of **wh**-interrogatives, the "input" for the abstraction is a structured proposition, i.e. what is expressed by a $THAT_\tau$ -clause. Since a written surface-that-clause has in general more than one "logical form", a **wh**-interrogative will be semantically ambiguous. Consider the following- examples.

(1) Who gave Ruth this cake? - Ede.

(2) Who gave Ruth this cake? - Ede.

The logical analyses of these question-answer pairs are (3) and (4) respectively.

(3) $\lambda\mathbf{x}<\lambda\mathbf{y}[\mathbf{x}\text{ gave }\mathbf{y}\text{ this cake}], \text{Ruth}>$ - Ede

(4) $\lambda\mathbf{x}<\lambda\mathbf{y}[\mathbf{x}\text{ gave Ruth }\mathbf{y}], \text{this cake}>$ - Ede

If I utter the interrogative in (1) and I am happy with your answer, then I henceforth ascribe the property $\lambda\mathbf{y}[\text{Ede gave }\mathbf{y}\text{ this cake}]$ to Ruth. Or perhaps I believe the two-place property $\lambda\mathbf{xy}[\mathbf{x}\text{ gave }\mathbf{y}\text{ this cake}]$ of <Ede, Ruth>. This situation is represented by (3).

If I ask the interrogative in (2) and your answer satisfies me, then I henceforth ascribe the property $\lambda\mathbf{y}[\text{Ede gave Ruth }\mathbf{y}]$ to this cake. Or perhaps, I attribute the $\lambda\mathbf{xy}[\mathbf{x}\text{ gave Ruth }\mathbf{y}]$ to <Ede, Ruth>. This is the situation depicted by (4).

Clearly, the two situations are different and the contents of the two **wh**-interrogatives are different, too. When I spoke of "focus-sensitivity" of interrogatives, at the beginning of this section, this kind of difference was what I referred to. In (1), Ruth is a focus and in (2), this cake is a focus. This difference in "focus-assignment" causes a difference in content.

Usually, it is assumed that a categorial answer is a "focus". Correspondingly the **wh**-word which is "filled" by the answer must be a "focus", too. (Cf. e.g. Wunderlich (1981)). At least the "fronted" wh-phrase should be a focus. People have said this, but I know of no theory which represents this. In my system, "foci" are reconstructed as the arguments of a structured proposition, i.e. given a structured proposition $<\mathbf{P}_1,\mathbf{a}_1,...,\mathbf{a}_n>$ $\mathbf{a}_1,...,\mathbf{a}_n$ are the foci. You may call **P** the topic of the structured proposition. It is a consequence of this view that the **wh**-word must be represented as an argument of a structured proposition, if it is regarded as a focus.

Consider our examples (1) and (2) again. The logical analyses (3) and (4) are not yet entirely correct. Better candidates for the "logical forms" of (1) and (2) are (5) and (6) respectively.

(5) $\lambda\mathbf{z}<\lambda\mathbf{xy}[\mathbf{x}\text{ gave }\mathbf{y}\text{ this cake}],<\mathbf{z}\text{ Ruth}>>$ Ede.

(6) $\lambda \mathbf{z}<\lambda \mathbf{xy}$ [**x** gave Ruth **y**],<**z**, this cake>> Ede.

These analyses correctly represent the fact that the <u>who</u> is a bound focus, <u>viz</u>. the bound variable **z**. (5) and (6) represent the "perhaps-paraphrases" I gave when I commented on the "logical forms" (3) and (4). I will assume, henceforth, that (5) and (6) correctly represent (3) and (4). I hope it is clear from these remarks what the general idea is which underlies my analysis of interrogatives.

Let me now develop a formal semantics for interrogatives. Consider **wh**-interrogatives first. The source of wh-interrogatives are THAT_τ -clauses. THAT_τ -clauses are in category **N**, **wh**-pronouns will be interpreted like **N**-variables. I assume that "**wh**-movement" means λ-abstraction. Consequently, **wh**-interrogatives are abstracts in category (**N/N**). For instance, a logical form of (7i) is (7ii).

(7) i. Who likes Senta?
ii. $<\lambda \mathbf{x}_1, <\text{WH}_\tau, <\lambda,\mathbf{x},\mathbf{y},<\mathbf{x},<\text{LIKES}, \mathbf{y}>>>, \text{WHO}_1,\text{SENTA}_2>>$, where
$\tau = (\mathbf{N/S/N^2}),\mathbf{N^2})$.

WHO_1 has the same meaning as the variable $\mathbf{x}_i$ hence it can be bound by the λ-operator, as is seen in (7ii). WH_τ, has the same meaning as THAT_τ.

(8) WHO_i is in category **N** for any number i . $|\text{WHO}_i|_v = v(\mathbf{x}_i)$, $\mathbf{x}_i \in \mathbf{X_N}$

Thus, we identify WHO_i with the variable $\mathbf{x}_i$. . In doing so, we ignore the restriction to persons in the case of "who" and the restriction to non-persons in the case of "what", and we assume the same semantics for WHAT_i.

Notice that the semantics of WHO_i is perhaps not general enough for reasons given in Engdahl (1980). Consider the following question-answer pairs:

(9) i. Whom does every Englishman love?
ii. The Queen
His motherf

Our semantics can explain the meaning of the first answer, but not of the second. Suppose the logical form of (9i) is (10). (I am ignoring the focus structure.)

(10) $\lambda \mathbf{x}_1$[WH, Every Englishman loves WHO_1]

Here, WH is of category (**N/S**), <u>i.e</u>. the object of belief is simply a proposition. If I ask (10), you answer "The Queen", then I henceforth believe that every Englishman loves Elisabeth II. If you answer "His mother", the situation is more difficult. In case I believe you, I may come to believe that (∀**x**)(If **x** is an Englishman, than **x** loves **x**'s mother). Thus, in the context (9), "his mother" can mean '**x**'s mother' , where **x** is bound by the universal quantifier. We can't account for this, if we assume that the meaning of the answer is obtained by application of the λ-abstract representing the interrogative to the categorial answer and if we further assume that "his mother" simply means '**x**'s mother". The free variable **x** can't be bound) if '**x**'s mother' is the argument of the abstract. Elisabet Engdahl solves this problem by means of a more complicated semantics for "who" and pronouns in general. In her system, "his mother" is a Skolem-function **f** which assigns **x**'s mother to any **x**. "**Wh**-movement" is interpreted as abstraction over Skolem-functions, not over individuals. The logical form of .(9i) roughly is

(11) $\lambda \mathbf{f}\,[(\forall \mathbf{x})$(If $\mathbf{x}$ is an Englishman, than $\mathbf{x}$ loves $\mathbf{f}(\mathbf{x})$)]

If we apply this to the Skolem function denoted by "his mother", we get the right meaning for the answer. I am, however, ignoring this complication. It is obvious that the semantics of **wh**-words can be accomodated along these lines, provided we like Elisabet Engdahl's solution. Engdahl's point is, of course, also valid for the determiner interrogatives "which" and "what". Again, I will ignore the complications mentioned.

(12) $WHICH_i$ is an (**NP/CN**) (for any number i). $|WHICH_i|_v$ is that function φ in $\mathbf{M}_{(NP/CN)}$, such that for any $\omega_1 \in \mathbf{M}_{CN}$ and any $\omega_2 \in \mathbf{M}_{IV}$ and any **c**:

i. $\varphi(\omega_1)(\omega_2)(\mathbf{c})$ is defined only if $\omega_1(\mathbf{c})(\nu(\mathbf{x}_i)(\mathbf{c}))$ is defined and $\omega_2(\iota_{\nu(\mathbf{x}i)}(\mathbf{c}))$ is defined. ($\iota_{\nu(\mathbf{x}i)}$ is the constant individual character giving $\nu(\mathbf{x}_i)$ for any **c**.)

For any ω_1, ω_2 and **c** meeting this condition and any <**w,t**>:

ii. $<\mathbf{w,t}> \in \varphi(\omega_1)(\omega_2)(\mathbf{c}) \Leftrightarrow <\mathbf{w,t}> \in \omega_1(\mathbf{c})(\nu(\mathbf{x}_i)(\mathbf{c}))$ and $<\mathbf{w,t}> \in \omega_2(\iota_{\nu(\mathbf{x}i)}(\mathbf{c}))$. _

Consider our old example (13).

(13) Which mountain is <u>this</u>?

A possible logical form of (13) is (14).

(14) $<\lambda,\mathbf{z},<WH, <\lambda,\mathbf{x}_1,\mathbf{y},<<WHICH_1 , MOUNTAIN>,<\lambda, \mathbf{x},<\mathbf{x}, <IS,\mathbf{y} >>>>,\mathbf{z},THIS^N{}_2 >>$,
with
$\tau = (N/S/N^2), N^2)$.

This analysis is straightforward, but since it is different from any proposal made in the literature, it needs careful explanation. Suppose, for simplicity, that "which mountain" is a name. We assume that this *wh*-expression and "this" are the foci of (13). According to what we have said so far, the logical form of (13) must then roughly be (15):

(15) $\lambda \mathbf{m}_1<\lambda \mathbf{xy}[\mathbf{x} = \mathbf{y}]$, which$_1$ mountain, this>

"which$_1$ mountain" is the variable $\mathbf{m}_1$ which ranges over mountains. This variable is bound by the λ-operator. Suppose I ask you (15) and you give me the answer 'Mount Rollestone' If I am happy-with your reaction, I henceforth ascribe $\lambda \mathbf{xy}[\mathbf{x} = \mathbf{y}]$, <u>i.e</u>. the property of being the same, to Mount Rollestone and this. The greater complexity of (14) is due to the fact that "this mountain" is not analyzed as a name but as a nominal , <u>i.e</u>. an **NP**. Therefore, we have to replace (15)by (16):

(16) $\lambda \mathbf{z}<\lambda \mathbf{x}_1\ \mathbf{y}$[which$_1$ mountain $\lambda \mathbf{x}\ [\mathbf{x} = \mathbf{y}]$, **z**, this >

(16) is almost identical with (14). The further complication comes from the technique of encoding the structure of the embedded open structured proposition by means of the symbol WH. Notice that (16) (=14) is not entirely equivalent to (15). The possible answers to (16) are not restricted to mountains anymore. If you answer my question (16) by "Max" and I am happy with that, then I henceforth ascribe the property $\lambda \mathbf{x}_1\ \mathbf{y}[\mathbf{x}_1$ is a mountain and $\mathbf{x}_1 = \mathbf{y}]$to <Max, this>.This shows that my account of WHICH is not entirely correct. <$WHICH_1$, MOUNTAIN> should better be analyzed as a variable $\mathbf{m}_1$ ranging over mountains.

Notice an interesting pecularity of my semantics. The **NP** <WHICH$_1$, MOUNTAIN> contains no visible variable of category **N**. Nevertheless it can be bound by "λ,$\mathbf{x}_1$". This is so, because the value of <WHICH$_1$, MOUNTAIN> depends on the variable assignment ν (cf. rule (12)).

Let me, at this stage, briefly comment on some differences between the present account of interrogatives and the theory of Karttunen (1977). Leaving details aside, a multiple interrogative like (17)

(17) Which student got which grade?

is roughly analyzed as (18) in Karttunens theory.

(18) λ**p**(∃**x**,**y**)[**p** & **p** = [**x** is a student and **y** is a grade & **x** got **y**]]

p is a variable ranging over propositions. Hence (18) is property of propositions. One motivation for this approach is that it accounts in a straightforward way for non-categorial answers which give us a "list". For instance, you may answer my question (18) by saying:

(19) Ede got an **A**, Mary got a **B** and Senta got a **C**.

If I am happy with that, I henceforth believe that Ede, Mary and Senta are students and Ede got an **A**, Mary a **B** and Senta a **C**. Prima facie , it looks as if I could not account for complicated answers of this type. On the other hand, Karttunen has to say something about the relation between **wh**-questions and lists containing categorial answers. For instance, (17) could also be answered by the list

(20) Ede an **A**, Mary a **B** and Senta a **C**.

Let us assume that the "logical form" of (20) is (21):

(21) {<Ede, **A**>, <Mary, **B**>, <Senta, **C**>}.

So a relation between (21) and (19) has to be established anyway. I consider this to be a minor problem. I have shown elsewhere (Cf. Stechow (1981a)) how to treat full answers of the type exemplified by (19) under the assumption that the logical form of (17) is not (18) but rather (22).

(22) λ**xy**[**x** is a student and **y** is a grade & **x** got **y**]

So "lists" like (19) are no compelling reason for preferring Karttunen's (18) to the simpler analysis (22). Karttunen has, of course, another motivation for his analysis. He wants to have uniformity of logical type for all interrogatives. I come back to this, soon.

I would, however, like to mention a difficulty of Karttunen s analysis. I have argued that the content of an answer is, in general, not a proposition but a structured proposition. Let us consider our examples (1) and (2) again, here repeated as (23) and (24):

(23) Who gave Ruth this cake? Ede.

(24) Who gave Ruth this cake? Ede.

How can we represent the difference in meaning in an approach which combines Karttunen s analysis with the present one? It is tempting to formalize (23) and (24) as (25) and (26) respectively:

(25) $\lambda\mathbf{p}\ \exists\mathbf{z}[\mathbf{p} = \langle\lambda\mathbf{xy}[\mathbf{x} \text{ gave } \mathbf{y} \text{ this cake}], \mathbf{z}, \text{Ruth}\rangle \ \&\ \mathbf{p} \text{ is true}]$

(26) $\lambda\mathbf{p}\ \exists\mathbf{z}[\mathbf{p} = \langle\lambda\mathbf{xy}[\mathbf{x} \text{ gave Ruth } \mathbf{y}], \mathbf{z} \text{ this cake}\rangle \ \&\ \mathbf{p} \text{ is true}]$

p is a variable ranging over structured propositions in both cases. We define '**p** is true' as the proposition $\mathbf{P}(\mathbf{a}_1, \dots, \mathbf{a}_n)$ if $\mathbf{p} = \langle \mathbf{P}, \mathbf{a}_1, \dots, \mathbf{a}_n\rangle$.

Such a move would be disastrous because it would make (25) and (26) equivalent. Take, e.g. the answers "Ede" in (23) and (24). Their "full" analyses had to be (27) and (28) respectively:

(27) $\langle\lambda\mathbf{xy}[\mathbf{x} \text{ gave } \mathbf{y} \text{ this cake}], \text{Ede}, \text{Ruth}\rangle$

(28) $\langle\lambda\mathbf{xy}[\mathbf{x} \text{ gave Ruth } \mathbf{y}], \text{Ede}, \text{this cake}\rangle$

The result of applying (25) to (27) and (26) to (28) is the same, viz. (29):

(29) Ede gave Ruth this cake.

Consider, e.g., the result of applying (25) to (27). It is the proposition

(*) $(\exists\mathbf{z})[\langle\lambda\mathbf{xy}[\mathbf{x} \text{ gave } \mathbf{y} \text{ this cake}], \text{Ede}, \text{Ruth}\rangle = \langle\lambda\mathbf{xy}[\mathbf{x} \text{ gave } \mathbf{y} \text{ this cake}], \mathbf{z}, \text{Ruth}\rangle \ \&$
$\langle\lambda\mathbf{xy}[\mathbf{x} \text{ gave } \mathbf{y} \text{ this cake}], \text{Ede}, \text{Ruth}\rangle \text{ is true}]$

Obviously, (*) is equivalent to (29). The same result is obtained, if we apply (26) to (28). So (26) and (27) mean the same, and all the distinctions we have made in order to account for the difference in meaning between (1) and (2) would be fruitless. Therefore, (25) and (26) are no good. I see no obvious way of repairing this and still keeping the spirit of Karttunen's analysis.

One motivation for Karttunen' s theory was that his analysis of interrogatives made it easy to account for indirect questions. Let us therefore see how this works in the present proposal. The most complicated verb is knowing, because it takes **that**-clauses and **wh**-clauses as complements.

(30) i. I know that Ede gave Ruth this cake.
ii. I know that Ede gave Ruth this cake.

(31) i. I know whether Ede gave Ruth this cake.
ii. I know whether Ede gave Ruth this cake.

(32) i. I know who gave Ruth this cake. -
ii. I know who gave Ruth this cake.

The following list contains the rough "logical forms" of (30i) to (32i) (vide the a-lines) respectively,together with the intended readings (vide the b-lines).

(33) a. I know that $\langle\lambda\mathbf{x}[\mathbf{x} \text{ gave Ruth this cake}])\ \text{Ede}\rangle$
b. Ede gave Ruth this cake & I ascribe $\lambda\mathbf{x}[\mathbf{x} \text{ gave Ruth this cake}]$ to Ede.

(34) a. I know whether $\langle\lambda\mathbf{x}[\mathbf{x} \text{ gave Ruth this cake}], \text{Ede}\rangle$
b. [Ede gave Ruth this cake $\Leftrightarrow$ I ascribe $\lambda\mathbf{x}[\mathbf{x} \text{ gave Ruth this cake}]$ to Ede] & [Ede
didn't give Ruth this cake $\Leftrightarrow$ I deny $\lambda\mathbf{x}[\mathbf{x} \text{ gave Ruth this cake}]$ of Ede]

(35) a. I know **wh**-$\lambda\mathbf{x}\ \langle\lambda\mathbf{yz}[\mathbf{y} \text{ gave } \mathbf{z} \text{ this cake}], \langle\mathbf{x}, \text{Ruth}\rangle\rangle$

b. $(\forall \mathbf{x})[[\mathbf{x}$ gave Ruth this cake $\Leftrightarrow$ I ascribe $\langle\lambda \mathbf{yz}[\mathbf{y}$ gave $\mathbf{z}$ this cake], to $\langle \mathbf{x}$, Ruth$\rangle]$ &
$[\mathbf{x}$ didn't give Ruth this cake $\Leftrightarrow$ I deny $\langle\lambda \mathbf{yz}[\mathbf{y}$ gave $\mathbf{z}$ this cake], of $\langle \mathbf{x}$, Ruth$\rangle]]$

Let me remark on the biconditionals in (34) and (35). This analysis is inspired by Hintikka (1973) analysis of "knowing whether". Thus, (3'Oi), i.e. "I know whether Ede gave Ruth this cake", is analysed as "If Ede gave Ruth this cake, then I ascribe $\lambda \mathbf{x}[\mathbf{x}$ gave Ruth this cake] to Ede. And, if Ede didn't give Ruth this cake, then I deny $\lambda \mathbf{x}[\mathbf{x}$ gave Ruth this cake] of Ede." To deny $\mathbf{P}$ of $\langle \mathbf{a}_1, \ldots, \mathbf{a}_n\rangle$ means, of course, to ascribe the complementary property P to $\langle \mathbf{a}_1, \ldots, \mathbf{a}_n\rangle$. Hintikka's 'knowing, whether' is, of course, not a "structure-sensitive" operator like our 'knowing whether' The difference can be seen best if we compare the analysis of (31i), viz. (34), with the analysis of (31ii), viz. (36).

(36) a. I know whether $\langle\lambda \mathbf{x}$[Ede gave $\mathbf{x}$ this cake], Ruth$\rangle$
b. [Ede gave Ruth this cake $\Leftrightarrow$ I ascribe $\lambda \mathbf{x}$[Ede gave $\mathbf{x}$this cake] to Ruth] &
[Ede didn't give Ruth this cake $\Leftrightarrow$ I deny $\lambda \mathbf{x}$ [Ede gave $\mathbf{x}$ this cake] of Ruth].

Clearly, (35b) and (36b) are different propositions, though (31i) and (31ii) differ only in the stress pattern of the embedded **wh**-clause. So our account makes precise F. Dretske' s suggestion that difference in stress may cause a difference in truth-conditions. (Vide Dretske (1972) and Dretske (1977)).

Let me, before writing a meaning rule for "knowing", give an informal but general account of its meaning.

(37) a. $\mathbf{x}$ knows that $\langle \mathbf{P}, \mathbf{a}_1, \ldots, \mathbf{a}_n\rangle :\Leftrightarrow \mathbf{P}(\mathbf{a}_1, \ldots, \mathbf{a}_n)$ & $\mathbf{x}$ ascribes $\mathbf{P}$ to $\mathbf{a}_1, \ldots, \mathbf{a}_n$.
b. $\mathbf{x}$ knows whether $\langle \mathbf{P}, \mathbf{a}_1, \ldots, \mathbf{a}_n\rangle :\Leftrightarrow [\langle \mathbf{P}, \mathbf{a}_1, \ldots, \mathbf{a}_n\rangle \Leftrightarrow \mathbf{x}$ ascribes $\mathbf{P}$ to $\mathbf{a}_1, \ldots, \mathbf{a}_n]$ &$[\sim\mathbf{P}(\mathbf{a}_1, \ldots, \mathbf{a}_n) \Leftrightarrow \mathbf{x}$ denies $\mathbf{P}$ of $\mathbf{a}_1, \ldots, \mathbf{a}_n]$.
c. $\mathbf{x}$ knows **wh**-$\lambda \mathbf{x}_1, \ldots, \mathbf{x}_n \langle \mathbf{P}, \mathbf{a}(\mathbf{x}_1, \ldots, \mathbf{x}_n)\rangle :\Leftrightarrow (\forall \mathbf{a}_1, \ldots, \mathbf{a}_n)\, [[\langle \mathbf{a}_1, \ldots, \mathbf{a}_n\rangle$ satisfies $\mathbf{P}(\mathbf{a}(\mathbf{x}_1, \ldots, \mathbf{x}_n)) \Leftrightarrow \mathbf{x}$ ascribes $\mathbf{P}$ to $\mathbf{a}(\mathbf{x}_1, \ldots, \mathbf{x}_n)\, [\mathbf{a}_1/\mathbf{x}_1, \ldots, \mathbf{a}_n/\mathbf{x}_n]]$ & $[\langle \mathbf{a}_1, \ldots, \mathbf{a}_n \rangle$ doesn't satisfy $\mathbf{P}(\mathbf{a}(\mathbf{x}_1, \ldots, \mathbf{x}_n)) \Leftrightarrow \mathbf{x}$ denies $\mathbf{P}$ of $\mathbf{a}(\mathbf{x}_1, \ldots, \mathbf{x}_n)[\mathbf{a}_1/\mathbf{x}_1, \ldots, \mathbf{a}_n/\mathbf{x}_n]]$

Notice that (b) is a special case of (c), if we think of $\langle \mathbf{P}, \mathbf{a}_1, \ldots, \mathbf{a}_n\rangle$ as a zero-place abstract. It would be nice if we could find a single condition which also incorporates (a) as a special case. I am not trying to do this. I distinguish between "knowing that" and "knowing wh-". Before giving a formal semantics for the two, let me briefly comment on the question how a sentence which embeds the complicated interrogative (17) is analyzed.

(38) God knows which student got which grade.

The logical form of (38) roughly is (39).

(39) God knows wh-$\lambda \mathbf{xy}\langle\lambda \mathbf{zw}[\mathbf{z}$ is a student & $\mathbf{w}$ is a degree & $\mathbf{z}$ got $\mathbf{w}], \langle \mathbf{x},\mathbf{y}\rangle\rangle$

According to (37c), this is the following proposition.

(40) ($\forall$**xy**) [[**x** is a student & **y** is a degree & **x** got **y** $\Leftrightarrow$ God ascribes λ**zw**[**z** is a student & **w** is a degree & **z** got **w**], to <**x**,**y**>] & [**x** is no student $\vee$ **y** is no degree $\vee$ **x** didn't get **y** $\Leftrightarrow$ God denies λ**zw**[**z** is a student & **w** is a degree & **z** got **w**],of <**x**,**y**>]].

Suppose the situation described by (19) (or 21)) obtains,i.e. Ede got an **A**, Mary a **B** and Senta a **C**. Then, according to (40), the following is a fact.

(41) Ede, Mary and Senta are students & Ede got an **A** & Mary got a **B** & Senta got a **C** & God ascribes λ**zw**[**z** is a student & **w** is a degree & **z** got **w**] to <Ede, **A**>, <Mary, **B**> and <Senta, **C**>.

So (39) seems to express the intuitively correct proposition. These remarks sufficiently motivate the following meaning rules.

(42) $\text{KNOW}_{\underline{that}}$ is a symbol of category (**IV/N**). $|\text{KNOW}_{\underline{that}}|$ is that function φ in $\mathbf{M}_{(\mathbf{IV/N})}$ such that for any $\iota_1,\iota_2 \in \mathbf{M_N}$ and any **c**:

(i) $\varphi(\iota_2)(\iota_1)(\mathbf{c})$is defined only if $\iota_1(\mathbf{c})$ is an intelligent being and $\iota_2(\mathbf{c})$ is a structured pro-position, $\langle \mathbf{P}, \mathbf{a}_1, \dots, \mathbf{a_n}\rangle$ say.

For any such ι_1,ι_2, **c** and any <**w,t**>:

(ii) $\langle \mathbf{w,t}\rangle \in \varphi(\iota_2)(\iota_1)(\mathbf{c})$ iff $\langle \mathbf{w,t}\rangle \in \mathbf{P}(\mathbf{a}_1, \dots, \mathbf{a_n})$ & $\iota_1(\mathbf{c})$ ascribes **P** to $\mathbf{a}_1, \dots, \mathbf{a_n}$ in **w** at **t** (where $\langle \mathbf{P}, \mathbf{a}_1, \dots, \mathbf{a_n}\rangle$ is, of course, $\iota_2(\mathbf{c})$

The logical form of (30i) would then be:

(43) $\langle \text{I},\langle \text{KNOW}_{\text{that}},\langle \text{THAT}_\tau, \lambda \mathbf{x}[\mathbf{x} \text{ gave Ruth this cake}], \text{EDE}\rangle\rangle\rangle$, with $\tau = (\mathbf{N/IV,N})$.

I am iqnorinq the internal structure of the abstract. We have already motivated why the semantics is correct. Let us go to "knowing **wh**-" next.

In order to formulate the meaning rule for "knowing **wh**-", let me introduce the following notation. Whenever we are given a structured proposition $\pi = \langle \mathbf{P}, \mathbf{a}_1, \dots, \mathbf{a_n}\rangle$ then <u>topic</u>(π): P and <u>foci</u>(π) : = $\langle \mathbf{a}_1, \dots, \mathbf{a_n}\rangle$.

(44) $\text{KNOW}_{\text{wh}_\tau}$ is a symbol in (**IV**/τ) for any $\tau = (\mathbf{N/N^n})$(n $\geq$ 0). $|\text{KNOW}_{\text{wh}_\tau}|$ is that function $\varphi \in \mathbf{M}_{(\mathbf{IV}/\tau)}$ such that for any $\omega \in \mathbf{M}_\tau$ any $\iota \in \mathbf{M_N}$ and any context **c**:

i. $\varphi(\omega)(\iota)(\mathbf{c})$ is defined only if $\iota(\mathbf{c})$ is an intelligent being and $\omega(\iota_1,\dots,\iota_n)(\mathbf{c})$ is a structured proposition for any sequence $\iota_1,\dots,\iota_n$ of constant **N**-characters.

For any such $\omega,\iota,\mathbf{c}$ and any <**w,t**>:

(ii) $\langle \mathbf{w,t}\rangle \in \varphi(\omega)(\iota)(\mathbf{c})$ iff $(\forall \mathbf{x}_1,\dots,\mathbf{x}_n)[[\langle \mathbf{w,t}\rangle \in \underline{\text{topic}}(\omega(\iota_{\mathbf{x}1},\dots,\iota_{\mathbf{x}n})(\mathbf{c}))$ applied to $\underline{\text{foci}}(\omega(\iota_{\mathbf{x}1},\dots,\iota_{\mathbf{x}n})(\mathbf{c})) \Leftrightarrow \iota(\mathbf{c})$ ascribes $\underline{\text{topic}}(\omega(\iota_{\mathbf{x}1},\dots,\iota_{\mathbf{x}n})(\mathbf{c}))$ to $\underline{\text{foci}}(\omega(\iota_{\mathbf{x}1},\dots,\iota_{\mathbf{x}n})(\mathbf{c}))]$ & $[\langle \mathbf{w,t}\rangle \notin \underline{\text{topic}}(\omega(\iota_{\mathbf{x}1},\dots,\iota_{\mathbf{x}n})(\mathbf{c}))$ applied to $\underline{\text{foci}}(\omega(\iota_{\mathbf{x}1},\dots,\iota_{\mathbf{x}n})(\mathbf{c})) \Leftrightarrow \iota(\mathbf{c})$ denies $\underline{\text{topic}}(\omega(\iota_{\mathbf{x}1},\dots,\iota_{\mathbf{x}n})(\mathbf{c}))$ of $\underline{\text{foci}}(\omega(\iota_{\mathbf{x}1},\dots,\iota_{\mathbf{x}n})(\mathbf{c}))]$.

As always, $\iota_{\mathbf{x}1}$ is the constant **N**-character which assigns $\mathbf{x}_1$ to any **c**. The rule looks a bit complicated, but it is nothing but a formal account of the semantics explained informally in (37) (b) and (c).

Consider two examples.

(45) God knows who likes <u>Senta</u>.

The logical structure is

(46) $<GOD,<KNOWS_{wh_\sigma}, <\lambda,\mathbf{x}_1, <WH_\tau ,<\lambda,\mathbf{x},\mathbf{y} <\mathbf{x},<LIKES,\mathbf{y}>>>,WHO_1 ,SENTA>>>$, with $\sigma = (\mathbf{N/N})$ and $\tau = (\mathbf{N/N^2})$.

This expresses the proposition which is true under the following condition:

(47) $(\forall \mathbf{z})[(z \text{ likes Senta} \Leftrightarrow \text{God ascribes } \lambda\mathbf{xy}[\mathbf{x} \text{ likes } \mathbf{y}] \text{ to} <\mathbf{z},\text{Senta}>)$ &
$(\mathbf{z} \text{ doesn't like Senta} \Leftrightarrow \text{God denies } \lambda\mathbf{xy}[\mathbf{x} \text{ likes } \mathbf{y}] \text{ of } <\mathbf{z},\text{Senta}>)]$.

The other example is the following.

(48) God knows whether <u>Ede</u> likes Senta.

It's "logical f6rm" is (49).

(49) $<GOD,<KNOWS_{wh_\sigma},<WH_\tau ,<\lambda,\mathbf{x}<\mathbf{x},<LIKES,SENTA>>>,EDE>>>$, with $\sigma = \mathbf{N}$ and $\tau = (\mathbf{N/IV,N})$.

Here, no **wh**-phrase is in the focus. In such a case, the "complementizer" WH_τ is realized as "whether". Notice that we also have a complementizer IF_τ, which has the same meaning as WH_τ. This complementizer nicely reflects the fact that there is a conditional aspect in the meaning of "knowing if", as the rule (44) reveals. The reader is invited to check that (49) expresses the proposition which is true iff the following two biconditionals are true.

(50) i. Ede likes Senta <u>iff</u> God attributes the property of liking Senta to Ede.
ii. Ede doesn't like Senta <u>iff</u> God attributes the property of not liking Senta to Ede.

Once we have a semantics for "knowing **wh**-", it is not difficult anymore to write meaning rules for other verbs embedding **wh**-interrogatives. Consider "to wonder". It is analyzed according to the following idea.

(51) **x** wonders **wh**-interrogative iff **x** wants to know_{wh} **wh**-interrogative.

It is, of course, not necessary to lexically decompose 'wondering' into 'wanting + to know_{wh}' . We can analyze 'to wonder' in one step, in view of the fact that (51) is synonymous with (52):

(52) **x** wonders **wh**-interrogative iff $(\forall \mathbf{y})(\mathbf{x}\ \mathbf{L}\ \mathbf{y} \Leftrightarrow \mathbf{x}$ knows_{wh} **wh**-interrogative)

where **L** is buletic Lewis-alternativeness. It is clear that the meaning rule for WONDERS will be very long, because it will incorporate the semantics of WANT (cf.(8.5)) and of $KNOW_{wh_\tau}$ But, to spell it out is pure routine, and therefore I abstain from doing so.

Let me, for the sake of completeness, write down the "logical forms" of the **wh**-interrogatives containing "essential indexicals", which motivated our reflections in section 1.

(53) i. What time is it now?
ii. $<\lambda,\mathbf{z},<WH_{\tau}\ ,<\lambda,\mathbf{x}_1,\mathbf{y},\ <<WHAT_1^{DET},\ TIME>,<\lambda,\mathbf{x}_2,\ \mathbf{z},\ NOW >>$

(54) i. What place is here?
ii. $<\lambda,\mathbf{z},<WH_{\tau}\ ,<\lambda,\mathbf{x}_1,\mathbf{y},\ <<WHAT_1^{DET},\ PLACE>,<\lambda,\mathbf{x}_2,\ <\mathbf{x}_2,\ <IS,\ \mathbf{y}>>,\ \mathbf{z},\ HERE >>$

(55) i. Who am I?
ii. $<\lambda,\mathbf{z},<WH_{\tau}\ ,<\lambda,\mathbf{x}_1,\mathbf{y},\ <WHO_1,\ <AM,\ \mathbf{y}>>,\ \mathbf{z},\ I >>$

In each case, $\tau = (\mathbf{N/(S/N^2), N^2})$. The semantics of $WHAT_1^{DET}$ is the same as that of $WHICH_1$.

Let me sum up. I see no problem in embedded interrogatives. So this theory certainly can do everything a theory of the kind proposed by Karttunen can. And it can do something else as well: It accounts for the focus-sensitivity of interrogatives and interrogative-embedding operators.

12. Some notes of the literature

Even in a longwinded paper like this I can't do justice to even a small part of the literature I am aware of. For instance, H.-N. Castaneda's "The logic of Self-Knowledge" (Castañeda (1967)) ,which presumably brought up the problem of essential indexicals, is not even -mentioned in the previous text and won't be mentioned anymore.

The problem reappears, for instance, in Anscombe (1975). I find certain passages of this paper rather obscure, but it contains some observations I subscribe to. Let me quote Ms. Anscombe:

"But the sense of the lie" I am not E.A." is hardly retained in "E.A. is not E.A."" (p. 53) This is certainly correct. I also like the following statement (p. 60):

"When a man does not know his identit, has, as we say, 'lost his memory', what he doesn't know is usually that that person he'd point to in pointing to himself (this is the direct reflexive) is, say, Smith, a man of such-and-such a background. He has neither lost the use of "I", nor is he usually at a loss what to point to as his body, or as the person he is.

But I don't agree with E. Anscombe on her solution (p. 60): "And this is the solution: "I" is neither a name nor another kind of expression whose logical role is to make a reference, at all."

She distinguishes "I" from other indexicals which may very well function as names:
"If I am right in my general thesis, there is an important consequence - namely, that "I am E.A." - is after all not an identity proposition. It is connected with an identity proposition, namely, "This thing here is E.A." But there is also the proposition, "I am this thing here"". (p. 60).

Let me say explicitly how I understand her claims:

(1) "I am E.A." is not an identity proposition, because "I" is not a refering expression.

(2) "This thing here is E.A." is an identity proposition, because "This thing here" is a referring expression.

(3) "I am this thing here" is not an identity proposition because "I" is not a referring expression.

I claim that each of these sentences has a reading according to which it is not an identity proposition though "I" is a referring expression like "this thing here" or "El isabeth Anscombe".

Suppose the sentences (1) to (3) are used in order to report beliefs, then they may express the following structured propositions

(1') <am E.A. , I>

(2') <is E.A., this thing here>

(3') <am,<I, this thing here>>

Suppose the belief takes place sub me hic et nunc. Then the objects of belief are the following properties, respectively:

(1") being E.A.

(2") pointing at something which is E.A.

(3") being identical with the object pointed at

Each of these self-conceptions is "subject-less", as Anscombe correctly requires on p. 65: "These conceptions are subject-less"[15]

But to conclude from this that "I" is never a referring term is a non sequitur. "I" always is a referring term, even if it is no “part" of the content of belief. In this sense it is not different from other indexicals. Remember also that puzzles of the kind noticed by E. Anscombe arise not only with "I" but with any other indexical as well. Notice, incidentally, that Anscombe's paper is an attack against Kripke's theory of rigid designators. It should be clear from the whole article that I think Kripke is right.

The theory of structured propositions proposed in this article is certainly connected with Perry's work, e.g. Perry [1979]. Perry, however, never proposes an explicit semantics for attitudes.

Thus, if I speak of Perry's views, I have in mind the reconstruction of his thoughts given by D. Lewis [1979]. So let me assume that , for Perry, the object of an attitude is a structured proposition in the sense explained in this article. In Perry (1980), he says that this theory can't work "for that irritating class of believers who accept other than atomic sentences" (p. 4). He concludes from that that a new kind of semantics"is needed (he has in mind some work he is developing together with J. Barwise). Let us briefly investigate what it could be that makes Pery believe so.

[15] Anscombe says: "In Latin we have "ambulo" = "I walk". There is no subject-term. There is no need for one." (p. 65).

This is not quite correct. If I utter the entirely subject-less "ambul are", my interlocutor presumably takes me for what I am, a German barbarian. Furthermore, he is wondering whether I mean ambulo, ambulas, ambulat,..." or something else of the paradigm of this verb.

Frankly, I can't answer this convincingly. I will only have some guesses. Let us consider a "non-atomic" thought of Max's.

(5) Max thinks that Ede likes Senta and Otto likes Tanya.

Never mind the clumsiness of the embedded that-clause. Let us ask what its "propositional structure" is. We get a problem, if we assume that the and is a connective that takes two structured propositions as arguments. Is this Perry's point? Structured propositions are **N**'s and and is a sentential connective. In the above case, and would have to apply to the pair

(6) <<λ**x** [Ede likes **x**]; Senta>; <λ**y** [Otto likes **y**]; Tanya>>

What should the result of applying and to (6) be? Presumably the structured proposition (7):

(7) <λ**xy**[Ede likes **x** and Otto likes **y**]; Senta,Tanya>

(I have omitted our THAT in (6) and (7). Its role is played by the semi-colon ";".) There would be no problem to define "and" that way. But there is a simpler way of getting (7). We assume that the "logical form" of (5) is (8):

(8) Max thinks <THAT, λ**xy**[Ede likes **x** and Otto likes **y**], Senta ,Tanya>

The procedure sketched in the appendix, which converts (5) into its "logical form", gives us (8) in a straightforward way. Notice that Cresswell's and my proposal also allows to account for complex interrogatives:

(9) Does Ede prefer pizza or does he prefer spaghettis?

The logical form of this is (10):

(10) <WH, λ**xy**[Ede$_1$ prefers **x** to y or he$_1$ prefers **y** to **x**], pizza, spaghettis >

In both (7), (8) and (10), and or or is in each case an ordinary sentential connective. (We can't answer (10) simply by yes, because, if we ask (10), we presuppose that Ede doesn't prefer both pizza to spaghettis and spaghettis to pizza.) It is also possible to treat tag- interrogatives in a rather natural way. (Vide Wunderlich (1981)). Consider (11):

(11) Whom does Ede like, Senta or Luise?

The logical form of -this is (12):

(12) λ**z**$_i$<WH, λ**x** [(**x** = Senta or **x** Luise) and Ede likes **x**], whom$_i$ >

A reasonable answer to this could only be "Senta" or "Luise", exactly as we would expect.

To conclude this discussion, let me say that I see no reason to believe that the method of structured propositions can't account for "non-atomic" objects of attitude.

Let me say a few words on Stalnaker. I have attributed the method of diagonalization to him. I am not sure whether Stalnaker would be happy with my way of representing his theory. First, my diagonalization operator is a semantic procedure. But for Stalnaker, diagonalization is a pragmatic thing. I hope, however, that the connection between diagonalization and pragmatics which I have discussed in section 6 is in the spirit of Stalnaker's theory. Notice that my account of diagonalization is more general then Stalnaker's original account. He insists that the result of a diagonalization is always a proposition. Clearly, we can always have this on my account of diagonalization. Consider again one of our examples.

(13) I believe that I am Max.

If we represent this as (14), we get a property as an object of belief, if we represent (13) as (15), we get a proposition:

(14) I believe Δ(I am Max_1)

(15) I $\lambda\mathbf{x}$ [I believe Δ ($\mathbf{x}$ and Max_1)]

(15) could be represented equivalently by means of Stalnaker's dagger-operator +, which diagonalizes only over worlds (vide Stalnaker (1978)):

(16) I believe f(I am Max_1)

Stalnaker can't represent (14) at al. So my account of diagonalization can do more than Stalnaker's. But I have argued that even my account of diagonalization is not general enough.

I have already said that I don't agree with Stalnaker's view that the objects of attitudes are propositions. Stalnaker' s theory of attitudes seems to me to be wrong at this point. On the other hand, I think that this paper nevertheless takes up a lot of his basic ideas: There is a uniform semantics for the words of natural language. The words mean the same, whether they occur in an "opaque" context or not. On my proposal, the "reinterpretation" which Stalnaker proposes for sentences under an attitude is reflected in the different structure of the "structured" proposition they express. What the right structure is, is not determined by the syntax alone but by pragmatic considerations of the kind discussed in section 6.

Let me conclude my notes on the literature with a few remarks on Kaplan's "monumental, but still unpublished" paper on demonstratives Kaplan (1977). Kaplan would call an operator like the diagonalization operator a monster. " … no operator can control the character of the indexicals within its scope … Operators … which attempt to meddle with character, I call <u>monsters</u>. I claim that none can be expressed in English (without sneaking in a quotation device)"(p. 32). And a bit earlier he says about monsters: "And such operators could not be added to it [viz. English]".

I think Kaplan is right in this. When I developed the semantics for my λ-categorial language, I said that I deliberately departed from Kaplan. I wanted to have the λ-operator as a non-logical symbol of my lanquaqe. And this operator, of course, meddles with character. The further development of the paper showed that the λ-operator had to be given up anyway. Everything would have become simpler, had I followed Kaplan's advice from the beginning. In section 10 I had to introduce a complicated semantic manoeuvre (cf. definition (10.4) which was caused only by the fact that definition (17)(V3) in section 7 allowed for an embedding of characters. Let me indicate briefly how my ontology had to be changed in order to conform the spirit of Kaplan's remark.

Definition (7.14) has to be replaced by

(7.14') A <u>system of characters</u> is a function **M** from the categories into the semantic domains such that for any category σ, $\mathbf{M}_\sigma$ is a function from the set of contexts into $\mathbf{D}_\sigma$

The definition of variable assignment (7.15) is replaced by

(7.15') For each $\mathbf{x} \in \mathbf{X}_\sigma$ and $\nu \in$ Ass, $\nu(\mathbf{x}) \in \mathbf{D}_\sigma$

And the interpretation function $\mathbf{V}_\nu$ is defined by the following conditions:

(7.17') Let ~ be any expression, and let c be any context.

V1'. If $\alpha \in \mathbf{F}_\sigma$, then $\mathbf{V}_\nu(\alpha)(\mathbf{c}) = \mathbf{V}(\alpha)(\mathbf{c})$

V2'. If $\alpha \in X_\sigma$, then $\mathbf{V}_\nu(\alpha)(\mathbf{c}) = \nu(\alpha)$

V3'. If $\alpha = <\delta, \alpha_1, ..., \alpha_n>$, then $\mathbf{V}_\nu(\alpha)(\mathbf{c}) = \mathbf{V}_\nu(\delta)(\mathbf{c})(\mathbf{V}_\nu(\alpha_1)(\mathbf{c}), ..., \mathbf{V}_\nu(\alpha_n)(\mathbf{c}))$

V4'. If $\alpha = <\lambda, \mathbf{x}_1, ..., \mathbf{x}_{n,\beta}>$ with $\mathbf{x}_1, ..., \mathbf{x}_n$ in $\mathbf{X}_{\sigma(1)}, ..., \mathbf{X}_{\sigma(n)}$ respectively and β in $\mathbf{E}_\tau$, then $\mathbf{V}_\nu(\alpha)(\mathbf{c})(\mathbf{a}_1, ..., \mathbf{a}_n) = V_{\nu(a(1)/x(1),\ldots,a(n)/x(n))}{}^{(\beta)(\mathbf{c})}$ for any $\mathbf{a}_1, ..., \mathbf{a}_n$ in $\mathbf{D}_{(\sigma)1},\ldots,\mathbf{D}_{(\sigma)n}$

V5'. Let α be an **S**. Then $V_\nu(<\Delta, \alpha>)(\mathbf{c})$ is that property ω in $\mathbf{D}_{(S/N)}$ such that for any $\mathbf{a} \in \mathbf{D}_N$ and any $<\mathbf{w,t}>$: $<\mathbf{w,t}> \in \omega(\mathbf{a})$ iff $<\mathbf{w,t}> \in V_\nu(\alpha)(\mathbf{c}')$, where $\mathbf{c}' = \mathbf{c}\ \mathbf{a}/\mathbf{a_c}\ \mathbf{w}/\mathbf{w_c}\ \mathbf{t}/\mathbf{t_c}$

I am assuming that Δ is a logical symbol , not in any syntactic category. The new definition shows the parallelism between the λ-operator and the Δ-operator. Both operators are abstractions, but they modify ("diagonalize over") different parameters. The λ-operator modifies variable-assignments whereas the Δ-operator modifies contexts.

It is pure routine to modify the meaning rules given in this article to the extent that they fit the new definitions. Everything becomes much easier. (In Stechow (1981b) I used a system of this kind. Kaplan's "Logic of demonstratives" is also a system of this kind, though without types and without the Δ-operator. (*Vide* Kaplan (1977)) In the modified system it is possible to introduce THAT$_\tau$'s for any of theτ of the form $(\mathbf{N/(S/}\sigma_1,\ldots,\sigma_n\mathbf{)}, \sigma_1,\ldots,\sigma_n)$, for any categories $\sigma_1,\ldots,\sigma_n$.In the old system, τ had to be of the form $(\mathbf{N/(S/N^n),N^n})$.(I have discussed the reasons for this restriction at the beginning of section 10).

This generalization will allows us to distinguish between(17)and (18):

(17) Ede hates fish.

(18) Ede hates fish.

These sentences have the byical form (19) and (20), respectively:

(19) $<\text{THAT}_\sigma, \lambda\mathbf{x}_{\mathbf{TV}}$ [Ede **x**-s fish], hate $>$

(20) $<\text{THAT}_\tau, \lambda\mathbf{x}_N$ [Ede hates **x**], fish $>$

$\mathbf{x}_{TV}$ is a variable for transitive verbs and a is $(\mathbf{N/(S/TV),TV})$. In the old system, we could not express (19). It is, of course, also possible that a quantifying **NP** is a focus:

(21) God loves everyone.

This will have the logical form (22)

(22) <THAT, $\lambda \mathbf{x}_{NP}$ [God loves **x**], everyone>.

I want to conclude my remarks on Kaplan with a comment on his refutation of Direct Acquaintance Theories of direct reference. On page 67 he writes:

"A kidnapped heiress, locked in the trunk of a car, knowing neither the time nor where she is, may think 'It is quiet here now' and the indexicals will remain directly referential."

Kaplan comments on this in a footnote: "Can the heiress plead that she could not have believed a singular proposition involving the place **p** since when thinking 'here' she didn't know she was at **p**, that she was, in fact, unacquainted with the place **p**? No! Ignorance of reference is no excuse.

On page 68 we read the following conclusion

"From this it follows that a special form of knowledge of an object is neither required nor presupposed in order that the person may entertain as object of thought a singular proposition involving that object."

When I read this for the first time, I couldn't understand it. Now, I have at least a partial interpretation. For me, a singular proposition is simply a structured proposition, where the foci are individuals. The singular proposition which is the object of the heiress’s thought is the following one:

(23) <λ**lt** [It is quiet at **t** at **l**], here$_c$ now$_c$>

Here$_c$ and now$_c$ are the place and the time where the heiress's thought-token is produced.
The object of thought is, in Kaplan's terminology, the structured proposition (23). Since the contents of sentences are, on my proposal, in general structured propositions, (23) is the content of the heiress's thought-token (24):

(24) It is quiet here now

So my account is in agreement with Kaplan's equation (25), which is found on p. 60:

(25) Objects of thought(Thoughts) = Contents.

The example also shows that an object of thought may involve an object the subject is (at least in some sense) not directly acquainted with. In the above case, here in (24) refers to here$_c$ and the now to now$_c$ though the heiress neither knows where she is nor what time it is.

But how is the heiress related to here$_c$ and now$_c$? Obviously, by the egocentric relations 'the place where I am' and 'the time when I am'. I have called relations like these relations of acquaintance (cf. section 5). The example, however, suggests that this might be a misnomer. It is, perhaps, odd to say that I am acquainted with some particular place I have no knowledge of except for the knowledge expressed by 'I am here'. Perhaps, the term "egocentric description" is a better one.

So far, everything I proposed seems to be compatible with Kaplan's theory. Kaplan, has, however, another principle. On page 60, we find the following equation:

(26) Cognitive significance of a thought = Character.

I must confess, I don't yet understand this entirely. Consider, again, our example. Suppose the heiress's thought (23) takes place under the relations 'the place where I am' and 'the time at which I am'. Then the de se-thought of the. heiress is something like the following property:

(27) λ**p**[The place where **p** is at the time at which **p** is is quiet]

We get this property if we diagonalize over the character of (24). In other words, (28) expresses something. like (27):

(28) Δ(It is quiet here now).

So,oneway of understanding Kaplan's equation (26) is the following:

(29) Cognitive significance of a thought = Δ(Character).

I am not sure whether that would be a fair account of Kaplan's intentions. But (29) is good enough to explain example (24) and everything we have discussed when we were dealing with diagonalization. In section 9,however, I have argued that an account of attitude by means of diagonalization is not general enough.

APPENDIX: SURFACE SYNTAX AND "LOGICAL FORM"

I have an "interpretive' model of grammar like Chomsky's recent theory in mind (vide Chomsky (1981)). Chomsky assumes that there is a syntactic part proper of the grammar. This part generates structures ("S-structure") which are converted into "phonetic forms" and "logical forms" by appropriate "interpretive rules". I am interested only in rules of-the latter kind which I will call "rules of construal". (Never mind that this form is used in a more restricted sense in the literature.) I don't want to commit myself to controversial details of Chomsky's theory (For instance, it is a controversial question what the internal structure of the syntactic part of the theory is: Are there only the levels of D-structure and S-structure, which are connected by "Move-α", as Chomsky (1981) assumes, or is there an intermediate level of **NP**-structure as is assumed by Riemsdijk (1981)).

For my purpose it is best to assume that the "rules of construal" apply to "deep structures", i.e. to structures where the **wh**-phrases have not been moved yet. I make this assumption for purely expository -reasons. When I was trying to write this, it turned out that things would become more complicated if I took Chomsky's S-structures as input for my rules.

The rules of construal which I will focus on are the following three: focus assignment, focus interpretation and **wh**-binding.

Let me sketch these rules now.

(1)Assign focus!

This means that you may assign the index **F** to any referring **NP**, i.e. to any "name". (The restriction to referring **NP**'s is immaterial. It is caused by my restrictive ontology. In Stechow and Cresswell (1981), any constituent may be a focus.) Furthermore, any **wh**-word automatically gets an **F**.[16] The rule (1) applies optionally and a sentence may have more than one focus. Notice that I call the rule of focus assignment (1) a rule of construal for convenience only. In reality, this -

[16] Perhaps, not every wh-phrase is a focus, but at least the fronted. one.

rule is at least partially a phonetic rule (accounting for differences in stress and intonation) and partially a syntactic rule (related e.g. to word order or clefts).

Let us apply (1) to the following sentence.

(2) Who gave Ruth this cake?

I ignore **wh**-movement and assume that, after focus-assignment, the structure of (2) is something like (3).

(3) $[[_F\text{Who}]\ [\text{gave}\ [_F\text{Ruth}]\ \text{this cake}]]$

I am assuming a "reasonable" indexing device, which assigns "referential" indices to any **NP**. ("Reasonable" means in this context that the indices have to meet restrictions of the kind discussed in Chomsky's GB-theory.) This indexing procedure converts (3) into (4).

(4) $[[_{F,1}\text{Who}]\ [\text{gave}\ [_{F,2}\text{Ruth}]\ [_3\text{this cake}]]]$

Our crucial rule is the next one.

(5) Interpret foci!

This means the following. You replace the focus-**NP**s by variables which are bound by the λ-operator. The foci move to the right into "focus-position", i.e. they form a sequence in the order in which they occur on the surface. At the same time,the index **F** is deleted. The whole structuring is encoded by an appropriate symbol: WH_τ in the case of interrogatives,$THAT_\tau$ in the case of indicatives. For our example (4), (5) will yield the following focus-structure:

(6) $<WH_\tau\ \lambda \mathbf{xy}[[\mathbf{x}][\text{gave}\ [\mathbf{y}]\ [_3\text{this cake}]],\ [_1\text{who}],[_2\text{Ruth}]>$, where $\tau = (\mathbf{N/(S/N^2),N,N})$.

It is obvious that there is an algorithm which converts (6) into an expression of our λ-categorial language, viz. (7):

(7) $<WH_\tau\ <\lambda\mathbf{xy}<\mathbf{x},<<GAVE,\mathbf{y}>, <THIS_3,CAKE>>>>, WHO_1,RUTH_2>.$

The function of the symbol WH_τ is to prevent the application of the λ-abstract (the topic) to the foci. It is very important to realize this. Consider the sequence

(8) $<<\lambda,\mathbf{x},\sim,<x,<<GAVE\ ,\mathbf{y}>,<THIS_3,CAKE>>>>,WHO_1,RUTH_2>$

According to our syntactic rules this is an **S**, because the topic is an (**S/N,N**) and the foci are both **N**s. But the symbol $WH_{(N/(S/N^2),N^2)}$ doesn't take an **S**, it takes a three-place sequence of symbols α, β, γ of category (**S/N**^{2}**),N,N**, respectively. So, if we were to analize (8) as an **S**, (7) could not be obtained. In this sense, the symbol WH_τ encodes the focus structure.[17]

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[17] The focus-semantics given in Jackendoff (1972) [p.246] fails at this point. He would analyze

(i) Ede likes Senta.

as

(i) $\lambda\mathbf{x}[\text{Ede likes}\ \mathbf{x}]\ (\text{Senta})$

The next rule I want to consider in this section is wh-binding.

(9) Bind **wh**!

Notice that the wh-phrase [$_1$who] in (6), i.e. the WHO_1, is "free" in (6) (or(7)). It has to be bound by λ-abstraction. This rule will convert (6) into (10):

(10) $\lambda \mathbf{x}_1 < WH_\tau\ \lambda \mathbf{xy}[[\mathbf{x}][\text{gave } [\mathbf{y}]\ [_3\text{this cake}]], [_1\text{who}],[_2\text{Ruth}]>$

The corresponding A-categorial expression is (11):

(11) $\lambda \mathbf{x}_1 < WH_\tau\ <\lambda \mathbf{xy}<\mathbf{x},<<GAVE,\mathbf{y}>, <THIS_3,CAKE>>>>, WHO_1,RUTH_2>$

In section 4 and 10 I said that **wh**-movement "means" λ-abstraction. It should be clear now that this is at best a <u>facon de parler</u>. **Wh**-binding is a rule of construal , it applies to any **wh**-phrase, whether moved or not. Remember the complicated interrogative (17) in section 10, here repeated as (12):

(12) Which student got which grade?

Assume for simplicity that the two wh-phrases are Ns. Then the i**NP**ut for (9) is something like (13):

(13) $<WH_\tau\ ,\lambda \mathbf{xy}[\mathbf{x} \text{ got } \mathbf{y}], \text{which}_1 \text{ student}, \text{which}_2 \text{ grade}>$, where $\tau = (\mathbf{N/(S/N^2), N^2})$.

wh-binding yields (14):

(14) $\lambda \mathbf{z}_1\mathbf{z}_2 < WH_\tau\ ,\lambda \mathbf{xy}[\mathbf{x} \text{ got } \mathbf{y}], \text{which}_1 \text{ student}, \text{which}_2 \text{ grade}>$

Here, **wh**-binding gives us a two-place abstract. But since only one wh-phrase is moved syntactically, **wh**-binding can't be the meaning of **wh**-movement.

Let me, at the end of this appendix, process one of Elisabet Engdahl's complicated examples (vide Engdahl (1980) p.145).

(15) Which of every student's results did someone forget to enter on his card?

We are interested in those readings where <u>his</u> is bound by <u>someone</u>. There are two possible readings then, <u>viz</u>. (16) and (17):

---

as

(i) <u>Ede</u> likes Senta

as

(iv) $\lambda \mathbf{x}[x \text{ likes Senta}](\text{Ede})$.

Obviously, (ii) and (iv) are equivalent. But Jackendoff seems to have in mind something very similar to what I am proposing here.

(16) $\lambda\mathbf{x}_1$[Someone $\lambda\mathbf{y}$ [Every student $\lambda\mathbf{z}$[**y** forgot to write which_1 of **z**' s results on **y**'s card]]]

(17) $\lambda\mathbf{x}_1$ [Every student $\lambda\mathbf{z}$ [,Someone $\lambda\mathbf{y}$ [**y** forgot to write which_1 of **z**' s results on **y**'s card]]][18]

Elisabet Engdahl says that the first reading is the unmarked one (unmarked with respect to the second, I guess). Let us see how we get (16) from the deep-structure underlying (15).

We assume a further rule of construal which accounts for the scope of quantifying **NP**s, i.e., something like May (1977) rule QR:

(QR) Adjoin **NP** to **S** and bind its original place (it's "trace") by the λ-operator.

The deep-structure of (15) is (18):

(18) Someone forgot to enter which_1 of every student's results,on his card.

We apply QR twice (we first raise every student and then someone) and obtain (19):

(19) [Someone Ay[Every student AZ [~ forgot to write which_1 of z' s results on his card]]]

Now we do two things: We "coindex" his with **y**, i.e. we replace his by **y** and we apply **wh**-binding. This will give us (16), here repeated as (20):

(20) $\lambda\mathbf{x}_1$[Someone $\lambda\mathbf{y}$[Every student λz[**y** forgot to write which_1 of **z**'s results on **y**'s card]]]

Notice that (20) is the logical form we wanted, but it doesn't account for Engdahl's problem, which we discussed in section 10, i.e. the question of what is bound by the λ-operator: (20) can't simply be a property of individuals, because then a true answer to (20) could concern only one result which is the same for every student. The existence of such a result is, however, very unlikely.

[18] For the notation "Every student $\lambda\mathbf{z}$ […]", vide section 7).

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